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# THE MISCHIEVOUS FALLACY OF OVER-PRODUCTION.

*By George H. Hull.*

It is not often that an industrial journal enjoys the privilege of presenting an economic discussion which is so apt, so able, so convincing, and so essentially practical, as the paper which Mr. Hull has here written. We commend it unreservedly to the thoughtful study of every reader of THE ENGINEERING MAGAZINE; and with the hope of adding something to the effective value of his sound teaching, we also invite attention to the Editorial Comment which appears elsewhere.—THE EDITORS.

MANY articles have recently appeared in the press discussing the threatened diversion of British manufacturing trade to other countries. No one of these has hit the nail so squarely upon the head, as that of Benjamin Taylor, of Glasgow, entitled "How Trade Unionism Affects British Industries." Mr. Taylor makes it clear that the all-pervading blight to British industry is the development of trade unions upon the controlling principle of "restriction of production," and that this has grown out of the widespread belief in the false theory of over-production.

He cites the fact that in America and Germany a workman may simultaneously "tend" several machines; that he often tends two, three, or even six; whereas in Britain, if a union worker dare attempt to tend more than one machine, he is brought before his district committee, reprimanded, and heavily fined. Many instances are cited where the union workman is limited in the amount of individual product to one-half, one-third, and one-fourth what a non-union worker will easily produce in the same time. One case is cited where a union worker was allowed to turn out but one-sixth, and another but one-twelfth what a non-union worker easily produced. Certain trades are mentioned in which the restriction of production increased until the

trades were driven entirely out of Britain into Germany and Belgium. Mr. Taylor recognizes that at the present time, "the great object in American production is the saving of labour," while "the great object in British trade-union production is the dissipation of labour."

As Prof. Jevons has pertinently said: "It is certain that if people do not understand a true political economy, they will make a false one of their own." Already the most potent factor in influencing workers to "nurse their jobs," limit their production and join in strikes, is their growing belief that over-production is the cause of industrial depressions; that if all the producers are fully and continuously employed, it will sooner or later result in over-production; that over-production would deprive many of them of work, whereas the curtailment of production, brought about by union regulations and strikes, prevents or postpones such results.

It is not alone in the minds of the mechanics and workmen that this pernicious belief in over-production is obtaining lodgment. It has already deluded thousands of manufacturers and merchants, and evidences of it frequently crop out in the commercial reviews of our ablest newspapers. The harm this mischievous term has done in Britain, and is commencing to do in America, is sufficient reason for the exposure of so obvious a fallacy. For the fact is that political economy is nothing more than a collection of every-day, common-sense, business truths; and the sooner industrial managers are aroused to an appreciation of this fact, the sooner we shall have stability, security and industrial peace.

The process of collecting natural products is called farming, or mining, or fishing. The process of chemical or mechanical change which fits them to satisfy the various wants of man is called manufacturing. The act of transporting them and placing them within the reach of the consumer is called commerce. Each act or process which adds to the utility and exchangeable value of matter is "production of wealth." Value is added to the tree in the forest by the effort expended in felling it. More value is added by sawing it into lumber; more value is added by transporting the lumber to a market; more value is added by fashioning the lumber into forms and shapes to satisfy the various wants of man. A mahogany log in a West India forest is relatively of small value; delivered in London or New York it is relatively of large value. The acts of chopping it down and transporting it to a market are just as much production of wealth as the voluntary process of nature in producing the tree.

Just as production is a creation of utility and value, so con-

sumption is a destruction of utility and value. Food is consumed by eating it; coal is consumed by burning it; lumber, stone, brick, and iron are consumed by using them in the manufacture or construction of things desired by man. Houses, ships, machines, clothing, and utensils, are consumed by wearing them out. In short, all creation of value, utility, and wealth, comes from production; all destruction of value, utility, and wealth results from consumption. The theory of over-production is founded upon the belief that by the introduction of machinery, improved methods, etc., it is possible for man to produce more than man is able to buy, or more than man desires to acquire. Let us analyze these propositions.

John Stuart Mill says: "What a country wants to make it richer is never consumption, but production. Where there is the latter, we may be sure that there is no want of the former." Professor Jevons also says: "People (British workmen for example) lose sight of the fact that we do not work for the sake of working, but for the sake of what we produce by working." Workmen everywhere are apt to think their comforts would be doubled if their pay was doubled. To analyze this, let us suppose that at a given time the pay of all persons engaged in any gainful occupation is doubled, while production remains the same. Is it not clear that the cost of everything would be doubled, and that each one with his double pay would be able to buy only as much as he did before? On the other hand, suppose that the pay remains the same to each, and that at a given time, by improved machinery, the productive force of each worker is doubled. Is it not plain that the cost of everything would be reduced one half, and that each one, on the same pay, would be able to buy twice as much as before? Obviously, then, the only practical way to double the reward to workers is to double their products; for as Professor Jevons strikingly observes: "It is absurd to suppose that people can become richer by having less riches. To become richer we must make more riches, and the object of every workman should be, not to make work, but to make goods as rapidly and abundantly as possible."

All great authorities agree that general over-production is an impossibility, though many admit that over-production in one or more articles frequently occurs. I take issue with all who make this admission. I claim that these exceptions are not cases of "over-production," but simply cases of *temporary surplus production*—and that temporary surplus production is not only natural but that it is necessary to man's comfort and welfare.

Man long ago discovered that the earth yields its food products

during short annual periods which we now call harvest; and that if he would enjoy these products continuously, he must gather and store up of the surplus during these periods, sufficient to satisfy his wants until the next harvest. This was man's first lesson: that temporary surplus production was a necessity to his comfort and welfare, and was not "over-production." Over-production is a term which should never be applied to the production of any useful or desirable commodity, which can be preserved or carried to a place or time when it will be needed.

Only a few years ago there were seasons when the receipts of fruit in all large cities were sometimes so great within a few days, and thereby prices were forced so low, that the fruit scarcely brought the amount of the freight. Very often large quantities went to decay for lack of demand. This in turn discouraged shipments, and then would succeed a season of great scarcity. It took experience and many years of loss to rectify this condition, but finally it was accomplished by the establishment of fruit exchanges and cold-storage warehouses, where fruits can be preserved in a perfect condition for months. The result is that prices of all such products are now more stable, the public is more regularly supplied, at all seasons, consumption has been enormously increased, and the profits of both producers and dealers are more uniform and remunerative. It was *temporary surplus production* of fruit, before it was brought under intelligent control, which caused irregularity in the supply.

In our ignorance we called it over-production.

It was not over-production.

It was *temporary surplus production.*

Despite all our efforts to prevent it, unerring nature persisted in thrusting before our notice as the one and only thing out of which it was possible to create regularity—a harvest season, a temporary oversupply. So we find vegetables, eggs, butter, fish, poultry, and many other perishable articles, getting the benefit of an intelligent system which brings regularity of supply out of irregularity of production. As man masters the art of dealing intelligently with the temporary surplus production of each article, we hear no more of over-production in connection with that article.

And what is true of perishable farm products, is true in even greater degree of all staple articles of manufacture. A few generations ago every nail produced was hammered out by hand. Now, by the aid of machinery, one man will turn out a thousand times as many nails as in the days of our grandfathers. During the interim,

the temporary inequalities between supply and demand have many times required to be adjusted to each other. We have had, in other words, frequent temporary surplus production of nails, but in the end the nails have been consumed. None have been destroyed for want of a market, and hence we have had no over-production of nails. The fact that such inequalities have always occurred and will continue to occur, simply emphasizes the importance of making some wiser provision than at present to turn them to profit when they do occur.

In Ecuador they mine gold by hydraulic power and must do it in daylight. But the streams are full of water at night and practically dry all day. So long as people lamented the nocturnal "over-production" of water, they produced no wealth. When they built dams to store the water at night, they provided means to mine by day. This is a striking example of the way we must turn to profit all cases of temporary surplus production of staple commodities. It is during periods of large production that we can most economically gather reserve stocks of such products as we know are sure to be in demand during periods of recurring prosperity.

Thus we see that man, though slowly, is learning to understand the wisdom of nature in giving him her products in temporary excess of current consumption, and that what man has long regarded as the disturber of regularity, and called over-production, was nature persistently thrusting upon his attention the only condition out of which he could possibly accumulate wealth and create regularity. If temporary surplus production of perishable products like fruit and vegetables is the only condition available for increasing consumption and creating stability in the supply and prices of these things, is it not reasonable to believe that temporary surplus production of imperishable articles, like iron and copper, is the only condition available for creating stability in the supply and prices of these staples? To waste the labor and the facilities to produce such commodities to full capacity in dull times, when it is certain they will be in great demand in active times, as Talleyrand says, "Is worse than a crime; it is a blunder."

The fact that most people believe that the accumulation of unsold goods is caused by "over-production," or that twin absurdity, "under-consumption," is not to be wondered at. On its face the theory seems to be self evident, just as it seems to be self evident that the sun rises and sets. But there is no more truth in one than in the other. This plausibility is what makes these terms so deceptive and mischievous, and probably no other popular error has done so much harm in the industrial nations of the world.

Each period marked by the accumulation of unsold goods in all industrial countries for a century past, has been a period of small production. History shows no instances in which a period of large production has been marked by the accumulation of unsold goods. Let us illustrate this by a period so recent that the truth must be plain to every one.

On October 1, 1898, the United States were producing iron at the rate of 10,800,000 tons per annum and had on hand a stock of 630,000 tons. The rate of production increased rapidly and by December 1, 1899, they were producing at the rate of 15,700,000 tons per annum and had but 124,000 tons of stock on hand. Why did not the stock increase during this period? Simply because the enormous production of wealth in the form of buildings, machinery, transportation facilities, etc., more than absorbed all the iron which could be produced.

From December, 1899, to December, 1900, the production of iron decreased to a rate of 11,200,000 tons; the stock increased from 124,000 tons to 720,000 tons, and immediately the cry of over-production was raised all over the country. What an absurdity, to cry over-production of iron when the country was actually producing less iron by 4,500,000 tons per annum than it was one year before, when there was no accumulation. The accumulation did not occur when the production was greatest. It occurred when production had been greatly reduced. It was the under-production of constructive enterprises which caused the accumulation of iron in 1900, as it did also the accumulation of all other constructive materials. Iron had risen in market value a clean 165 per cent. Coal, copper, tin, lead, rubber, lumber—indeed all the great staples followed the lead of iron, as is always the case; and with what result? People simply stopped buying. They saw plainly that prices were too high, and that they were certain to come down. Building plans were abandoned or laid aside, railway betterments were postponed, and manufacturers throughout all lines of industry limited purchases to actual daily needs. The natural and inevitable result followed: the price of iron and steel declined sharply —in Europe as well as America—all other prices followed, and immediately there was a resumption of constructive enterprise. More than this, every well-informed man now sees plainly that it was the fall in prices from an abnormal level which revived industry, stimulated enterprise, increased the demand for iron, and so stimulated production that the American output rose to the highest figures ever reached; and there are at present no signs of an accumulation of stocks.

By creating the modern systems of transporation, and by inaugu-

rating the present system of cold storage, two long strides have been taken. Neither of these advances would have been possible but for the existence of one of nature's greatest gifts to man, *temporary surplus production.* Yet another long stride forward will be taken when the producers of staple commodities like coal, iron, steel, tin, copper, lead, and rubber, clearly understand that the present systems of storing these products are wholly inadequate. In the case of perishable agricultural produce, Nature long ago made it necessary for the merchants and bankers who handle them to adopt scientific systems of negotiable warehouse receipts for their safe storage. But in the case of the less-perishable staples of manufacture, we are still hobbling along with the antiquated methods of our grandfathers—every producer for himself, and the devil take the hindmost! The result is shown in the violent fluctuations of market values which we have lately seen in coal, iron, steel, copper, and rubber—extreme fluctuations which are wholly needless, and which are certain to be rendered impossible so soon as producers, merchants, bankers, and brokers can be brought to see the demoralization and waste that spring from mere lack of system in storing and carrying temporary surplus supplies of materials which form the very basis of all industry and all wealth.

Is there anything in nature or history which does not teach man that if he would have anything when needed, he must gather it when it can best be produced? Is it not good business to gather surplus products when they are plenty and cheap and hold them until they are scarce and high? Have any ten years passed in the recollection of men now living, in which the people of the foremost manufacturing nations have not suffered for the want of an adequate supply of some of the great staples—coal, iron, steel, tin, copper, rubber—which might have been stored up in times of dull trade? Has any one ever heard of useful manufactured products being destroyed for want of a market? Have they not all been consumed in time? Is not this proof that each one of the over-production claims put forth during the last two and a half centuries has been rank nonsense? Has not modern society simply failed to grasp one of Nature's great truths?

Finally, is it possible for man to produce more than man desires to acquire? Let us consult the economists on this point. W. Stanley Jevons says: "There can never be, among civilized nations, so much wealth that people would cease to wish for any more. However much we manage to produce, there are still many other things which we want to acquire." John Stuart Mill says: "A little reflection must inevitably lead us to see that no person, no community, ever had, or prob-

ably ever will have, all its wants satisfied." David Ricardo says: "Whilst a man has any wished-for gratification unsupplied, he will have a demand for more commodities; and it will be an effectual demand while he has any new value to offer in exchange for them." Francis A. Walker says: "It is under-production which makes hard times. Over-production, general over-production, is impossible, and, were it to occur, were the creation of wealth to outrun men's capacity to consume, no one would be injured thereby. But under-production is an unmistakeable evil. It means less wealth produced, and consequently fewer of the comforts and necessaries of life, on the average, to each member of the community."

Thus we see that the only natural limit to a people's power to acquire, possess, and enjoy material wealth, is their capacity to produce wealth—that products in themselves are *buying power.* We see also that products are wealth; that wealth increases *in the proportion that production exceeds consumption;* that it is impossible for wealth to increase so rapidly, or so largely, that it would exceed man's desire to possess it, or his power to pay for it. It follows therefore that there cannot be too much production of any useful article that can be safely stored. In short, large production does not cause hard times, but on the contrary it creates industrial prosperity.

We see also that when production is cut down in any particular line of business, it cuts down the buying power of those engaged in that line of business. Immediately we see the piling-up and accumulation of the class of goods ordinarily consumed by those engaged in that branch of industry. The accumulation of unsold goods is not an evidence of too much production, but on the contrary of too little production by those workers who ordinarily consume that kind of goods.

The difference between the poorest nation on the globe and the richest is simply a difference resulting from the difference of production. Every day of idleness, every hour of loafing, or striking, or "nursing a job" is a permanent and irreparable loss to the producer, the employer, and the community. It is a sacrifice of something the worker might have possessed, and can no more be replaced than the lost day can be replaced. No obstacle should be allowed to stand in the way of man's capacity to produce to the utmost; nothing should be allowed to stand in the way of man's increasing his comforts, luxuries and wealth, except the natural limit to his energies.

There is no limit to human desire. Every man who owns a factory, a house, or a yacht, would like to own a larger or a better one. The man who controls a bank, would like to control a number of banks

and a number of trust companies. Having gained these, he would like to control great railroad systems, steamship lines, coal mines and manufactories. Having gained these in one country, he would like to control them in all countries.

Man's desires increase with his successes. Whatever one man achieves in wealth and power, others will desire to achieve, and will strive for. The average wealth of the individual in the United States has increased a thousand per cent. in less than a century, yet no man is so gorged with possessions that he desires no more. If in time the poorest live in the luxury in which the richest now live, there would still be a desire for more wealth. There are hundreds of millions in other lands who have not even commenced to produce wealth. Not one human being in twenty on this globe has to-day what might be called the reasonable comforts of life. The luxury and comfort of to-day was not conceived of a century ago, nor can the human mind to-day conceive of what will be regarded as the obtainable luxuries and comforts a hundred years hence. The desire to possess wealth and power is a natural instinct, implanted in man's breast by his Creator. It is this instinct which brings civilization out of barbarism. It is this instinct which moves the civilized world.

Whenever scarcity in the supply of any important commodity forces the price of that commodity up to the point of restricting its use—thus bringing on industrial depression—it is simply nature reminding us that there has been too little temporary surplus production of that article in the past.

Both nature and art give their products to man in a disproportionate manner, not to be wasted, but to be intelligently cared for; and if he does not so care for them, he is certain to suffer for his neglect.

Since the dawn of civilization the importance of storing up stocks of such things as were necessary to the life, defense and well being of man, has been recognized by all nations and people. The Scriptures, from Genesis to Revelation, abound in accounts of the immense store houses and store cities builded and maintained by the great nations of ancient times. They not only gathered in the months of harvest sufficient to supply the people until the next harvest, but they stored up in years of plenty sufficient to provide for years of famine. This wise provision ranked first in importance in all temporal affairs.

Is this one of the lost arts?

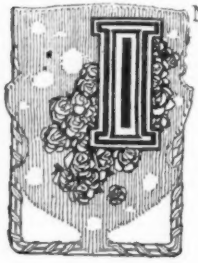
Verily what Thomas Arnold wrote years ago is still true: "What is called ancient history, is the most truly modern, the most truly living, and the most rich in practical lessons for every succeeding age."

# MONEY-MAKING MANAGEMENT FOR WORKSHOP AND FACTORY.

*By Charles U. Carpenter.*

## II.—A CONCRETE EXAMPLE OF SUCCESSFUL ADMINISTRATION.

**In his initial article of this series, in our preceding number, Mr. Carpenter developed a rational and economical system of organisation for controlling the detail operations of the factory. To prove its efficacy in actual work, in spite of its seemingly radical character, he now takes a concrete instance which by its long-assured and pronounced success proves the working efficiency of the scheme proposed. The next article will take up the details of receiving, keeping, and issuing stock and of the processes of machining.—The Editors.**



N considering the best methods of gaining an increase of work from the workmen in the factory, sanitation must always receive a large share of attention. In order to secure the very best results from men, their bodies must be in good physical condition, and their minds must be alert. Good light results in better and quicker work with a minimum of effort. Good air results in a more healthful condition of the body, a greater capacity for prolonged and concentrated effort, and an alert, wakeful mind. As a reply to the plea of expense for advanced methods of supplying and heating pure fresh air, may be quoted the answer of a manufacturer to an objector: "Yes, it does cost money for fuel to heat such a quantity of pure air, but my men don't become drowsy early in the afternoon; just as much work is being produced at 5:15 p. m. as at 7:15 a. m." The extra cost is a very small fraction of the final results. Fresh air, good light, and first-class sanitary facilities do pay a fine return on the investment necessary to secure them.

Suggestions and Complaints:—Many firms are neglecting what has proven, in many cases, to be a veritable mine of valuable information when they fail to adopt some means of inducing their workmen to make suggestions in the line of improvements. The workman comes in close contact with the minute details of the work, and his constant association with these details impels him to think of many improvements and economies that would never occur to the foreman or supervisor. A long experience has demonstrated that most valuable suggestions will be received from the men if they know that they will

receive full credit for their ideas and have an opportunity to win a monetary prize. To insure this a note should be sent to each person making a suggestion, no matter how trivial, thanking him cordially and assuring him that it will meet with serious consideration. The workmen will feel the slightest hint at a rebuff in a matter of this kind. The money prizes which should be offered need not be so large in amount as large in number. Certificates, which are invariably highly prized, should also be given to each prize-winner.

To insure success it is necessary that these suggestions reach the highest authority in the factory, directly. A number of firms have adopted autographic registers and placed them in different parts of their plant: the workman writes his suggestion on the paper which is exposed at the top of the machine, turns the crank, tears off and keeps his copy. A duplicate carbon copy is retained in the machine under lock and key and these duplicates are gathered by a messenger and delivered to the secretary of the board of supervisors, or to those who are highest in authority.

The most surprising results will follow an effort to interest the men, especially if the foremen join with the firm in persuading and advising their men to make these suggestions. This can be accomplished by giving the foremen to understand that the number of suggestions received from a department, after taking into consideration the nature of the work, is part of the basis on which the firm forms its opinion of their efficiency. The direct benefit to the firm in money value will inevitably be followed by a greater efficiency in the working force. The result will be a decided increase in the interest of the men in their labor, and a greater concentration of their minds on their work, which will naturally bring the best results. Each man is spurred on by the knowledge that his ideas will be presented to the highest officials without the intervention of any one, and that, if he shows by his suggestions any degree of ability, he will be a man marked for advancement. Again, the firm is thus able to pick out from the ranks of the workmen the men of ability with whom to strengthen the organization when the need appears. This in itself is a very decided benefit.

Such a system arouses the best qualities of every individual in the entire body of workers; each one feels that opportunity is within his reach, and that reward is certain if he but prove worthy. Its basic principles properly developed, must result in wise decisions, effective orders, freedom from costly errors, large economies, development of the best men, and a remarkable degree of personal interest on the part of all in the business of the firm.

Practical illustration of Working of System:—In order to illustrate better the effectiveness of these ideas, it will be well to cite a concrete case and describe the details of the system herein advocated as developed in a factory where it has been in practice for over six years, bringing results that are remarkable. I refer now to the National Cash Register Company, of Dayton, Ohio.

This factory is selected, first, because here the system is worked out to the fullest extent possible; as a result it is famed all over the world for its admirable management. Second, because in this factory the work is so varied in its character, the amount of stock handled is so large, and the need for accuracy is such, that the system may be considered as working under the most difficult conditions possible.

This development is due to the wonderfully progressive spirit and indomitable will of the president of the company, Mr. John H. Patterson. By him these methods have been carried into not only the factory management, but also the executive and sales branches as well, with what success the business world is quite familiar. His great genius for organization has had full sway here and the results have more than justified the statement already made that the system of organization as herein outlined is an unqualified success.

Character of Product:—In this factory there are manufactured 206 different styles of machines. A large number of the orders received are special. There are assembled and shipped each day an average of 160 registers, which represent the labor of 2,700 workers. In each of these machines there are from 1,200 to 3,000 parts. In all there are over 13,000 different kinds of stock carried. In the assembling rooms are handled an average of 300,000 pieces of stock each working day. In the inspection room, through which all stock must pass in its manufacture, there were handled in one year over two hundred million (200,000,000) pieces of stock, many parts requiring a number of operations. There are over 22,000 piece-work prices representing about 75 per cent. of the total number of operations on this stock. The machines are very intricate and the mechanism is of the finest. To add to the difficulties of the case, the machine rooms are of comparatively limited capacity. There are in all forty-five separate factory departments, including machine rooms of all kinds, assembling departments, blacksmith shop, large wood-working department, large brass foundry, polishing and plating rooms, an elaborate printing department, bindery, etching and photograph departments. These represent work of the most varied character.

Old Systems:—This company, operating under the old plan of

management, discovered that the systems were totally inadequate to meet the conditions that had arisen owing to the natural increase in the business. The system of management was inefficient, and the factory systems, including costs, stock, piece-work, inspection, stock-tracing, tool-making, and machining proved unreliable, cumbersome and very costly.

New Plan of Organization:—Finally a plan of organization, on the lines advocated in these articles, was determined upon. The board of supervisors* was formed, composed of five experienced men. The men composing this board were mechanical experts, inventors and experts in factory management and systems. They were chosen not only because of their ability in some particular lines, but also because of their sound judgment and ability in handling large affairs. At the meetings of this board the fullest and freest discussions prevail, with the result that all phases of any subject are fully brought out. Each man brings to these meetings his own ideas and his own wide experience, and each member avails himself of the privilege of taking up these ideas and discussing them with the other members of the board. The result is that the conclusions and orders of this board, having as a basis the experience of these five members, cannot but show the effect of the general discussions and the consideration that is given to any important question and, consequently, are remarkably effective. The efficiency of each member is naturally increased greatly owing to this free interchange of ideas.

Sub-Committees:—In addition to this board there were appointed a number of "machine committees" to take care of the complaints, suggestions, and improvements pertaining to the particular machine for which they were appointed. These committees are composed of the entire board of supervisors and foremen of the assembling, tool, tool-supply, stock and cost, and inspection departments. The work of these committees is of the greatest importance; all suggested improvements, inventions, and new designs, being carefully considered from the standpoint of every man on the committee, and any and all difficulties of any nature whatever being fully and freely discussed and methods adopted to correct them.

Very frequently other foremen are called into these meetings for consultation. The members of the committees and the foremen called upon soon become trained into the company's methods and they are very naturally developed into much stronger and more valuable men

* See THE ENGINEERING MAGAZINE, February, 1901, page 699.

to the company. The result is that the heads of factory departments come into closest contact, in many ways, with the details of the factory work. Every man is alive to make improvements and better the conditions of his department, for he knows his own efficiency is judged by that of the department of which he is the head. Each feels that he is, in fact, an active and important part of an organization in which no shirking can or will be tolerated, and at the same time one in which due credit will be given for a highly efficient department.

The comparison of the admirable results obtained by this method with those that might reasonably be expected under the ordinary system of management, will very strikingly demonstrate the advantages of this system and the great defects of the one in common practice.

Foremen's Meeting:—Every two weeks there is called a "foremen's meeting" in which all heads of departments meet with the entire board of supervisors, and at times the general manager. At these meetings care is taken to draw out the foremen, and they are given to understand that a free and full expression of opinion on any proposition is always valued, especially if it is in the nature of a criticism that may lead to some reform. Each man is given the fullest possible opportunity to ask for anything that may be needed to better his department and to complain of anything that is hindering him from reaching the desired point of efficiency. This general meeting is of great value in ascertaining the true cause of any difficulty that may exist. Both the management and the men are benefited by this free interchange of ideas and expression of opinion.

Company Club House:—The company has also provided a club house in which the noon-day meal is served to the officers of the company and all heads of both office and factory departments, all sitting at one table. Here are taken up many of the points of the business, a discussion of which might prove beneficial to both the men and the company. Hardly a week passes without the presence of some prominent guests, often from far-distant lands. The discussions that arise as to the methods prevailing in the different sections of the world are very instructive, and tend to broaden the horizon of the men as could nothing else. This bringing together of these men develops a feeling of fellowship and mutual interest between them and the management, the results of which are far-reaching. It is a great aid in bringing about that desire for co-operation with one another for the good of the company which has wrought such wonders in this particular case.

The heads of departments thus come into close contact with the offi-

cials of the company, and in case any one of them has made a marked improvement that will benefit the organization, his work is recognized in a manner that impresses all with the idea that the officers of the company thoroughly appreciate any worthy and successful effort to benefit a department and the organization. The inevitable result of this is that all are moved with one desire and aim, viz., to concentrate all their energies to improve their departments, to build up the company, and to strengthen the organization and increase its efficiency at every point.

General Committees:—In addition to these meetings of committees and boards, there is a building committee, an inventions committee, and also a joint meeting of the office and factory. The names of these committees are an indication of the nature of their duties, which are naturally of vast importance. In addition to these, there are a number of others formed in the executive, recording, and sales branches of the business.

Suggestions and Complaints:—In the matter of receiving and considering suggestions from the workmen, this company is probably in advance of any other concern in the world; as a consequence, their experience is the best possible foundation upon which to base a statement of facts. To those who have made no attempt to develop properly the possibilities in this line of improvement, the results will be astonishing. No doubt some tact and skill must be used in introducing such ideas, but when properly done and with proper encouragement, the savings and improvements will more than repay the firm making the experiment, many times over. And again, as mentioned before, the increased interest and attention of the men to their work is most beneficial to the entire organization.

Sanitation:—This firm has demonstrated that it does pay from a financial standpoint to give close heed to the question of sanitation. Their experience has shown beyond the possibility of doubt that good light, fresh air, and good closet facilities have a direct bearing upon the product of the workmen. So decided was the gain that their new shops were designed and built so as to give all the light possible, and ventilating systems instituted which permit of frequent changes of air kept at a very even temperature.

*Resumé*:—The experience of this company, building a machine that is extremely complicated and of many parts, necessitating great accuracy, as well as rapid and economical handling of an immense quantity of stock, has proven the great efficiency of its system. Its fundamental principles and final results can be stated in few words.

Discussions by committees:—Resulting in wise decisions, great economies, and efficient management.

Quick decisions:—Leading to rapid action.

Individual responsibility:—Tending to relieve officials of useless burdens.

Suggestions:—Resulting in important improvements and increased interest.

Complaints:—Forcing correction of serious faults.

Promotion:—Providing inspiration to individual effort.

General Meetings:—Resulting in a redoubling of interest and bringing forward of strong men.

Such an organization can not be otherwise than progressive, because of its encouragement of complaints and suggestions; flexible in its ability to meet any situation, however sudden; efficient and strong in its development of strong men, in its great reserve power, and because it rests upon the combined wisdom, intelligence, and ability of all its strongest members.

# THE GROWTH OF ECONOMY IN MARINE ENGINEERING.

*By Walter M. McFarland.*

There is no more remarkable example of the commercial value of applied science in engineering than the development exhibited in the domain of marine engineering. In the series of papers of which this is the first, Mr. McFarland traces that growth from the invention of the steamboat down to the present time, showing how the fuel consumption has been reduced to one-tenth of that required in 1825. Mr. McFarland's long and intimate connection with the Bureau of Steam Engineering of the United States Navy renders him especially well fitted to narrate the story of this marvellous development.—THE EDITORS.

## THE PERIOD OF THE SIMPLE ENGINE.

THE century which has just closed has witnessed enormous strides in every branch of engineering, and in none has the progress been greater than in marine engineering. At the beginning of the century, indeed, it may be said to have had no existence, while at the end it has reached such a state of development that further progress seems very difficult and the exact line along which it is to take place uncertain. To attempt a general review of marine engineering progress with any degree of detail would require a much greater space than could be afforded by this magazine, and in these articles consideration must be limited to the question of economy, treating this mainly with reference to the cost of power as measured in coal and steam per horse power, but also considering some features of design which have been productive of economy, although not directly in the reduction of the cost of power.

I shall not attempt to go back to the very beginning of steam propulsion in the latter part of the eighteenth century, for no data whatever are available of the cost of power at that time—and indeed the same may be said of the early years of the nineteenth century. It will not be amiss, however, to remind the reader that the beginning of commercially successful steam navigation was with the American steamer Clermont, designed and built under the supervision of Robert Fulton in New York, which made its first trip from New York to Albany in August of 1807. The engine of the Clermont was built by Boulton & Watt of England, and the boiler and hull at the ship-yard of Charles Brown on the East River. In the Clermont, as in most of the early steamers, pine wood was the fuel, and although there are some records of the cords of wood used for a trip, no attempt appears

Mr. Wellman. Prof. Thurston. Mr. Haswell. Admiral Melville. Rev. Mr. Crary.

DEDICATION OF THE MONUMENT TO ROBERT FULTON, TRINITY CHURCHYARD, NEW YORK.

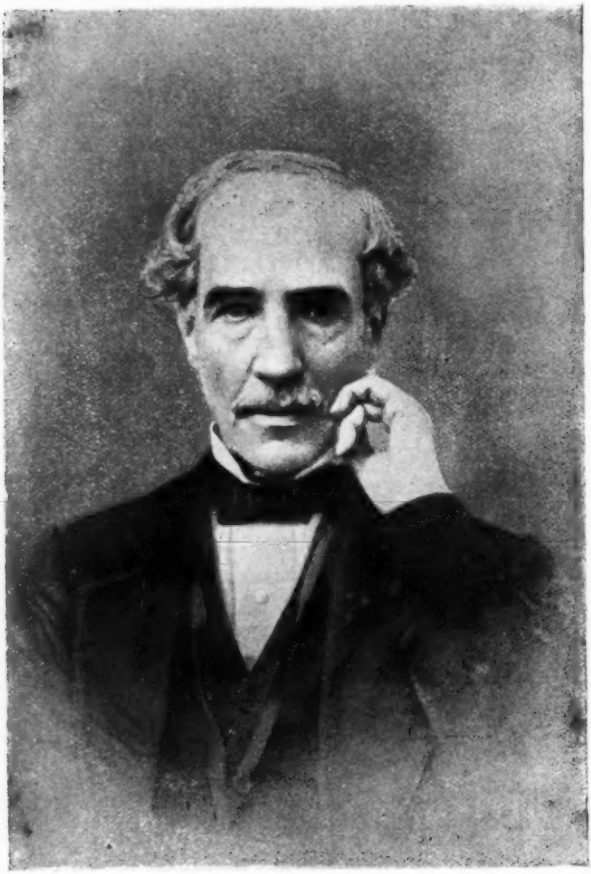
This photograph is interesting in that it contains the first Engineer-in-Chief of the U. S. Navy, Mr. C. H. Haswell, in his 94th year, as well as the present Engineer-in-Chief, Rear Admiral Geo. W. Melville, U. S. N. The others present are Mr. S. T. Wellman, President A. S. M. E.; Professor R. H. Thurston, and Rev. Robert Fulton Crary, grandson of Robert Fulton.

to have been made to determine the cost per unit of power. According to Doctor Thurston, anthracite coal was first used for fuel on the steam boat Passaic in 1818 under the direction of Mr. Robert L. Stevens, who was also the inventor at a later date of the familiar "Stevens cut-off," which is still used on so many beam-engine steamers.

These early steamers carried a very low steam pressure and used the steam without expansion. Moreover, as the paddle wheel was the propelling instrument, the rotational speed was very low, and as a result, in the light of our present knowledge, we should anticipate that the cost of power would have been very high. It is impossible to give absolutely accurate figures, inasmuch as no attempt appears to have been made to determine carefully either the horse power or the fuel expenditure. Some of the early writers on marine engineering mention the coal expenditure as ten pounds per indicated horse power, and, under the circumstances, this does not appear at all extravagant. We have some records of the first steam war vessel of the United States Navy—the Fulton—built in 1837, whose first chief engineer was Mr. Charles H. Haswell, the nestor of American engineering, who is still alive at the advanced age of ninety-four. An extract from the Fulton's steam log for a portion of January, 1838, shows that the maximum steam pressure was 11 pounds, the vacuum 24 inches, and the maximum revolutions per minute 18.

The early marine engines are a good exemplification of the law of evolution, for they were adaptations of the form of engine which had proved successful on land, with the consequence that they were of the type known as the "beam engine," and its modification, the "side-lever engine." The former has continued in use for light-draft American river steamers even up to the present day, and the side-lever engine was the favorite for sea-going steamers almost up to the close of the paddle-wheel period. What was known as the "inclined engine" was used in many cases for war vessels where it was desired to keep the machinery below the water line, and the old paddle-wheel steamer Michigan, which is still in service on the Great Lakes, was designed in 1843 with engines of this type.

As is well known, the benefit to be derived from using steam expansively was discovered at an early day and is included by Watt in his patent of 1769. It was, therefore, very natural that as soon as marine engines had shown their reliability progressive designers should endeavor to get the benefit due to expansion. As stated above, the Stevens cut-off was invented in 1841, and the Sickles cut-off was also invented about the same time and was applied to the engines of the



CHARLES H. HASWELL,

First Engineer-in-Chief in the U. S. Navy. Born 1809; Chief Engineer, 1836; Engineer-in-Chief from 1844 to 1850.

Michigan. That there was a reduction in coal expenditure was, of course, shown by the coal used per day or per trip, although there is still no record of the coal used per unit of power. Up to 1850 steam pressures were still very moderate, although many students of economy realized that the cost of power would be reduced if the steam pressure were raised so as to allow for greater expansion. The curious

feature to an engineer educated at the present time is that, although the steam-engine indicator was invented by Watt, and thus had been available for many years, it seems to have been very little used. The horse power of the engines was usually calculated from the boiler pressure and the dimensions of the engine, sometimes with an allowance for a fall of pressure, but there are no records of any tests having been made with the indicator. In a book written in 1850 by a British naval officer who was evidently anxious for improvement, we read such a statement as the following:

> "An indicator should be fitted to every cylinder and should be constantly fixed there in order that the effective pressure of the steam may be known by inspection at all times. It is usual in most cases merely to apply the indicator when the engine is about to leave the maker's hands, and, the power being calculated, it is removed. By making constant observations of the reading of the indicator we should at once perceive how much the evaporative power of the boiler decreases from incrustations or other causes, also the comparative effects of different kinds of fuel and modes of treating the furnaces. In short, the whole economy of the engine may be determined by it."

The author speaks of indicator diagrams, but, strange as it may seem, not a single diagram is given in the whole book. Under such circumstances it is not surprising that the economy remained low.

It is interesting to note that in all the discussions of the benefit to be derived from expansion it never seems to have occurred to the engineers of that time that there was any limitation. The expansion of steam was treated as if steam were a perfect gas, and the law of Mariotte, "that, with constant temperature, the product of pressure and volume is constant," applied without any limitations. It was, of course, realized that there was a practical limit to expansion, from the consideration that too great a ratio would cause a mean forward pressure so low that when the back pressure came to be deducted the mean effective pressure would be so small as to require a very large engine with its accompanying great friction. The effects of liquefaction were unknown, and, indeed, it does not seem to have been suspected that there was such a thing as liquefaction. The truth with respect to expansion and liquefaction was experimentally demonstrated and promulgated—if, indeed, it was not discovered—by that famous American engineer, Chief Engineer Benjamin F. Isherwood, who was the engineer-in-chief of the American navy during the civil war.

The first definite data of the cost of power which I have been able to discover, after considerable research, appear in a book by Chief Engineer Isherwood published in 1858, entitled "Engineering Prece-

CHIEF ENGINEER B. F. ISHERWOOD, U. S. N.

Engineer-in-Chief of the U. S. Navy, 1861-1869. Designer of the most successful marine engines of his time, contributing by his researches upon the action of steam in the cylinder, to the modern knowledge of cylinder condensation.

dents." Even at that early date Mr. Isherwood gave evidence of his genius and pains-taking analysis of engineering data. This book contains a number of indicator diagrams, some of which show very

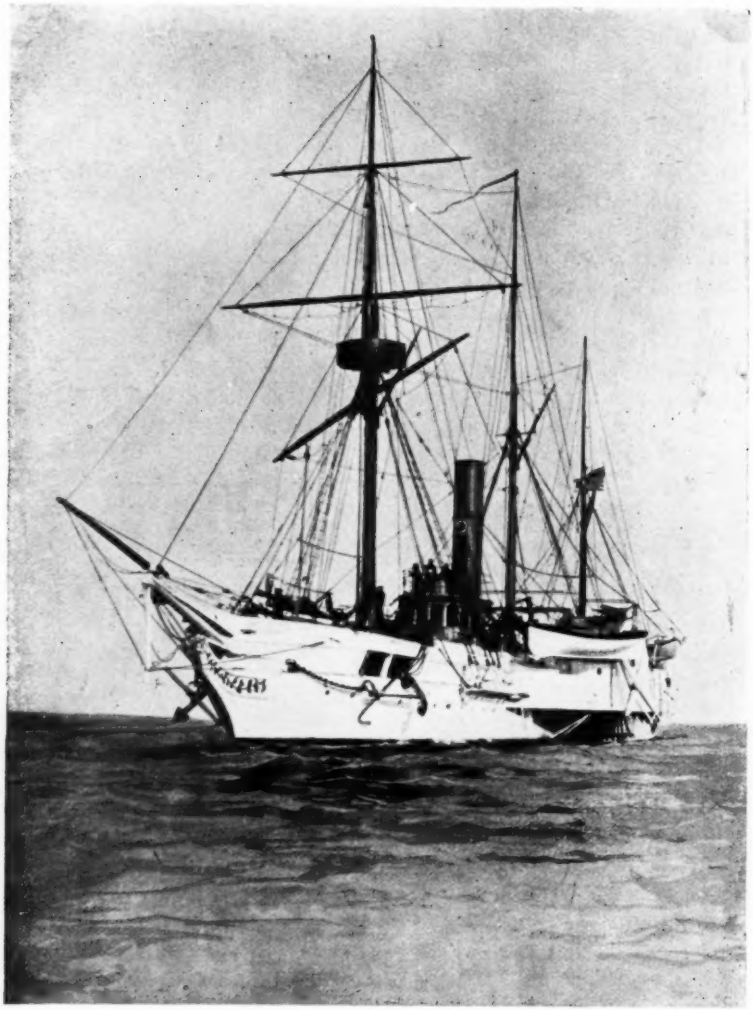
creditable steam distribution. It contains information in considerable detail with respect to the machinery of some English vessels built about 1855 and of about 840 horse power. The steam pressure was 9 pounds per square inch above the atmosphere and the coal consumption per day was 40 tons, which gives the coal per horse-power hour about 4½ pounds.

Mr. Isherwood became engineer-in-chief of the American navy in 1861, but before that time he had conducted the experiments which first made him famous, and the report of which has remained an engineering classic to this day. These were the experiments on the U. S. S. Michigan for the purpose of determining the limitations to expansion and the amount of liquefaction. The experiments were made by a board of naval engineers, of which Mr. Isherwood was president, and were conducted in January, 1861. The engine used was one of a pair 36 inches in diameter and 8 feet stroke. The boiler was of the Martin vertical water-tube type, having 45 square feet of grate surface and 1,385 square feet of heating surface. It may be remarked that this was the second set of boilers on the Michigan, and had been installed in 1859. These were still in use on the Michigan when I served on that vessel in 1882-3, and they were then in excellent condition. They were finally removed and replaced by a third set in 1892, thus having lasted thirty-three years, a record probably unique in marine engineering. The accompanying table shows the results of these experiments,

EXPERIMENTS ON EXPANSION, U. S. S. "MICHIGAN."

| | Point of Cut Off. | | | | | |
|---|---|---|---|---|---|---|
| | 7/10 | 4/9 | 3/10 | 1/4 | 1/6 | 4/45 |
| Ratio of expansion, including clearance | 1.4 | 2.12 | 2.95 | 3.42 | 4.60 | 7.15 |
| Steam pressure above atmosphere | 19.5 | 21.0 | 21.0 | 21.0 | 21.0 | 22.0 |
| Revolutions per minute | 15.56 | 17.28 | 13.69 | 13.87 | 11.17 | 14.1 |
| Mean effective pressure in pounds per square inch | 27.6 | 24.1 | 19.9 | 17.4 | 13.6 | 8.8 |
| Pounds of feed water (100° F.) per horse power per hour, tank | 34.8 | 33.08 | 35.2 | 34.47 | 37.04 | 46.08 |
| Per cent. of feed liquefied to equal work | 8.74 | 9.04 | 8.59 | 8.77 | 8.45 | 7.94 |
| Per cent. of feed not accounted for by indicator | 6.60 | 18.14 | 33.07 | 30.84 | 33.66 | 37.16 |
| Diameter of cylinders to give same power and speed, inches | 36.0 | 39.5 | 42.7 | 45.4 | 51.3 | 63.5 |

and from them we note at once the utter fallacy of the opinion almost universally held up to that time that the greater the degree of expansion the greater the degree of economy. As will be observed, the greatest economy occurred when the steam was cut off at four-ninths of the stroke, which, with the allowance for clearance, meant about two expansions. The table contains a line which shows the percentage of steam not accounted for by the indicator, or, in other words, the dif-



U. S. S. MICHIGAN.

Launched at Erie, Pa., in 1843, and still in active service, with the original engines. It was on this vessel that Mr. Isherwood conducted his famous researches.

ference between the water actually fed into the boilers and the quantity of steam which should have been required had there been no liquefaction other than that due to the expansion of the steam itself. It will be noted that for the highest grade of expansion this unaccounted for percentage amounts to as much as 37 per cent. of the total amount accounted for by the tank measurement, or, in other words, nearly 70 per cent. of the amount accounted for by the indicator.

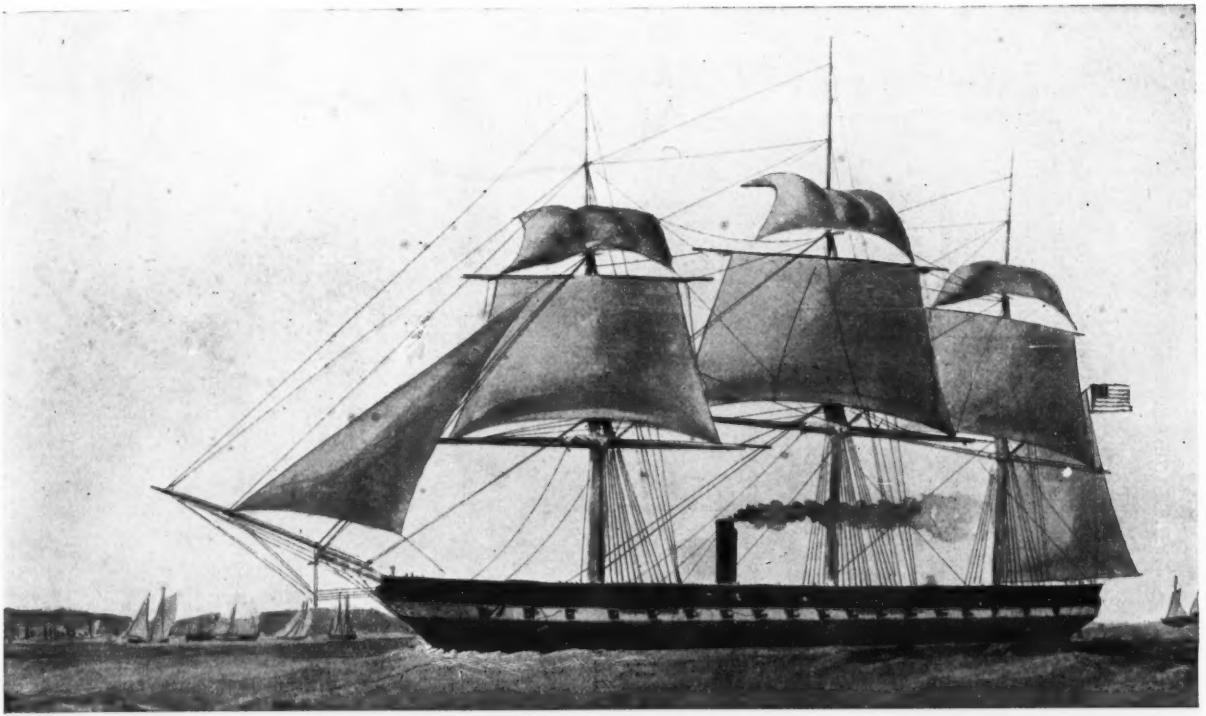
It would seem that the result of these experiments should have been to convince engineers of the futility of using high degrees of expansion with low-pressure steam and slow-moving engines, but this was not the case; and indeed the lesson was not thoroughly learned by some designers even as late as the eighties of the last century. During the American civil war there was an extremely heated controversy of great interest to all engineers, due to the attacks of a patent lawyer in New York named Dickerson, who was an amateur designer, upon Mr. Isherwood. Dickerson accused Mr. Isherwood of professional ignorance and of waste of government money in designing engines that worked with very low expansion. Dickerson had sufficient influence to be allowed to design the machinery for the U. S. S. Pensacola to embody his ideas with respect to expansion, and the machinery was a complete failure and had to be removed from the vessel. In spite of this he was again successful in getting permission to design another set of machinery, which was installed in the U. S. S. Algonquin. This vessel was similar in every respect, except machinery, to the U. S. S. Winooski, which was fitted with machinery designed by Chief Engineer Isherwood. The vessels were not completed until after the close of the civil war, when a series of competitive trials was conducted under the auspices of a board of marine engineers not connected with the navy, this arrangement being to prevent any complaint by Dickerson that his machinery had been tested by people friendly to Isherwood and hostile to him. The trials included runs at the dock and also in free route, and in both cases the Winooski with Isherwood's machinery was entirely successful, while Dickerson's on the Algonquin was a failure. The board concluded its report as follows: "In every point guaranteed by the contractor for the Algonquin machinery (Dickerson) he has failed, and we are of the opinion that it is totally unfit for the naval service."

In 1863 there appeared the first volume of Mr. Isherwood's work entitled "Experimental Researches." These included the record of the performance of a number of naval vessels on trial and in regular service, and also the detailed data of various experimental trials of

marine machinery made under Mr. Isherwood's direction, and in many cases under his personal supervision. In all cases they were accompanied by an analysis and discussion of the results by Mr. Isherwood himself. In this first volume are the records of the performance of a class of naval screw steamers built from 1854 to 1856, which were then the largest vessels in the American navy, one of them being the famous Merrimac. These vessels were of about 4,600 tons displacement, 300 feet long, 50 feet beam, and 21 feet draft. The engines were of about 1,300 horse power, working with a steam pressure of 13½ pounds above the atmosphere and making about 45 revolutions per minute. A record of the maximum performance in smooth water showed a coal consumption of 4.37 pounds of coal per horse-power hour. Under ordinary steaming conditions at sea, when a certain amount of heat was lost, due to "blowing off" to reduce the density of the water in the boilers (the condensers were of the jet variety), and using anthracite coal with 18 per cent. refuse, the coal consumption was six pounds per horse-power hour.

It is a little difficult in such an article as this to be strictly chronological without a break in the continuity. I have, therefore, not mentioned the change from paddle wheels to the screw as a means of propulsion. The screw propeller was actually used successfully on a small steamer as early as 1804; indeed this little boat of 68 feet length, built by Colonel John Stevens, used twin screws. The actual introduction of the screw propeller for large vessels was about 1836, by Ericsson and Smith. It seems probable that one of the main reasons which delayed the earlier introduction of the propeller was the comparatively inferior workmanship of that period, which made it difficult to construct engines which would run at the relatively high speed necessary for driving the propeller. As we now know, the very fact of increasing the rate of rotation caused an increase in economy by the reduction in the amount of condensation in the cylinders. Paddle-wheel steamers continued to be built even after the successful introduction of the screw propeller, and during the civil war in America some paddle-wheel steamers were built, but these were for special service where light draft was very necessary.

During this war the depredations of the confederate privateers—notably the Alabama—were so disastrous to American shipping that the Navy Department decided to build a class of vessels which would be faster than any others afloat, either in the naval or merchant service. The most famous of these vessels was the Wampanoag, whose machinery was throughout the design of Chief Engineer Isherwood, who also



U. S. S. MERRIMAC.

One of the finest warships of her day. Launched at Boston, Mass., 1855. Captured by the Confederates at Norfolk Navy Yard in 1861, and converted into the ironclad which was defeated by Ericsson's Monitor.

designed the lines of her hull. She was not completed until after the conclusion of the war, but in February, 1868, she was given a full power trial at sea from Sandy Hook to near Cape Hatteras. The performance was the most wonderful record for a steamer in the history of marine engineering up to that time, and in many respects it remains the most remarkable that has ever occurred. As the books which contain the record of this trial are now rather difficult of access, a brief statement of the performance is here given, because the record is one that should be known to all engineers.

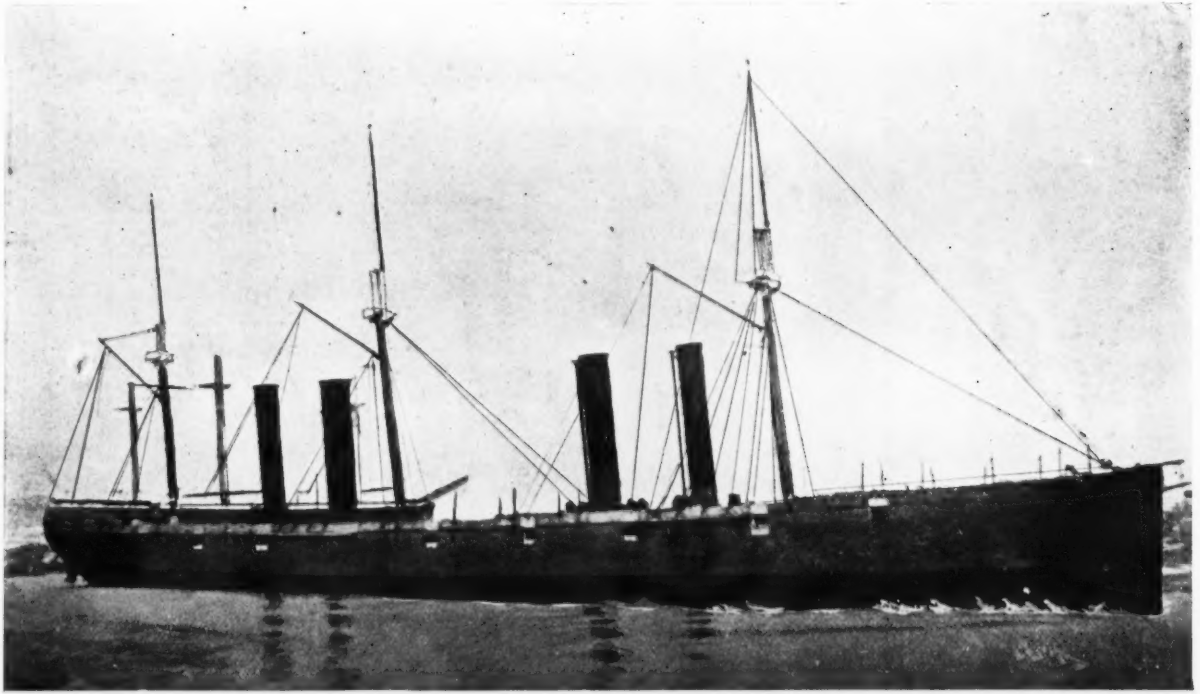
FULL-POWER TRIAL OF U. S. S. WAMPANOAG, AT SEA, FEBY. 11 AND 12, 1868.

| | |
|---|---|
| Duration of trial, hours | 37.5 |
| Average speed, knots | 16.7 |
| Highest average speed for six hours | 17.0 |
| Maximum speed, one hour | 17.75 |
| Revolutions of engines per minute | 31.06 |
| do. do. screw " " | 63.67 |
| Steam pressure in boilers, pounds | 32.0 |
| Vacuum, inches | 26.0 |
| Coal per hour, pounds | 12,690 |
| do. do. do. per indicated horse power, pounds | 3.15 |
| Indicated horse power | 4,049 |

The speed of the Wampanoag was greater by at least four knots than that of any other vessel then afloat, and it is to be noted, too, that this was not a fair-weather performance lasting only four hours with picked coal and high-priced firemen. The trial lasted for thirty-seven hours and was conducted in the winter off the Atlantic coast. The weather was indeed so stormy that the trial was ended by the coming on of a heavy gale. As seen by the table, the steam pressure carried was 32 pounds above the atmosphere and the coal consumption was 3.15 pounds per horse-power hour. We should doubtless not be far wrong in assuming that this cost of power represents about the best economy in simple engines working under good average conditions at sea.

During the whole of his term as engineer-in-chief, Mr. Isherwood took advantage of every opportunity to make careful tests of all the new classes of machinery built for naval vessels, and also of superheated steam, ratios of heating to grate surface in boilers, and, in general, whatever would conduce to progress and increased efficiency and economy.

Among these experiments were competitive tests of the horizontal fire-tube and the vertical water-tube boilers, which showed a slightly superior economy of evaporation for the latter, so that it became the common type in the navy. This boiler must not be confounded with the modern water-tube boilers, for it was a shell boiler. It had



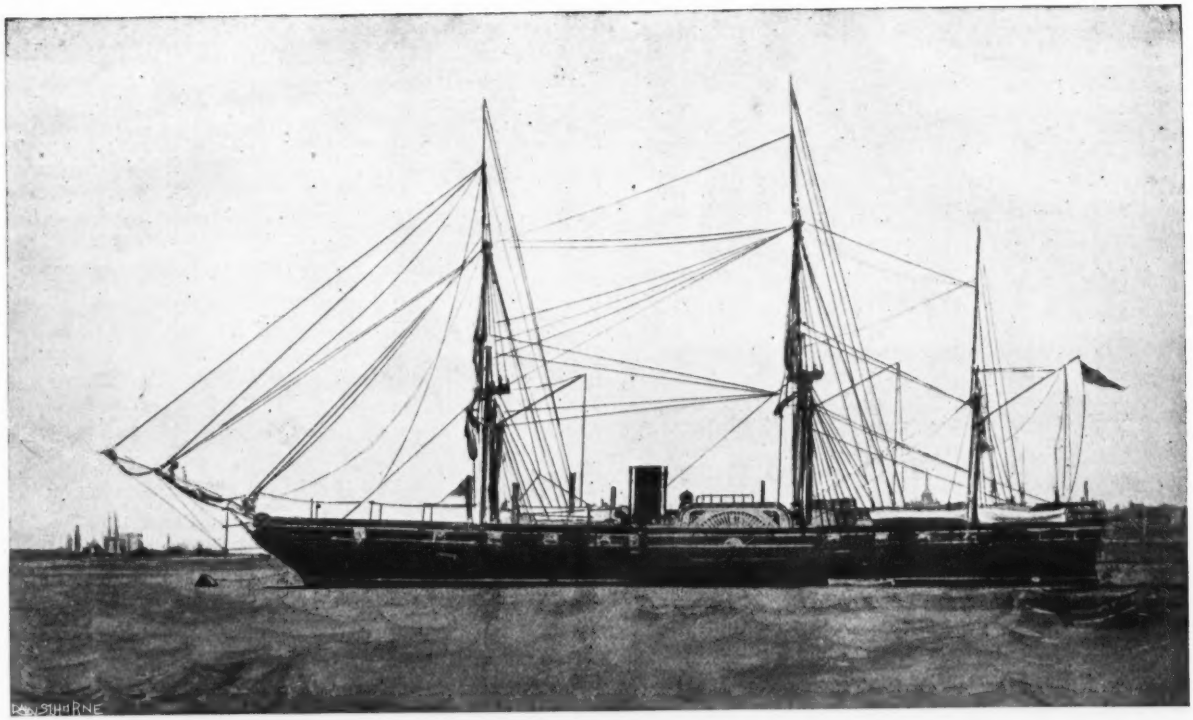
U. S. S. WAMPANOAG.

The fastest vessel of her day, having made a speed of 17.75 knots on her trial trip, February, 1868. The photograph represents the cruiser as she lay at New London, Conn., shortly before she was broken up.

none of the advantages of the later type, but did have all the disadvantages. One of these, the inability to plug a leaky tube without laying off the boiler, was largely conducive to its final abandonment. The experiments on ratios of heating to grate surface also gave valuable and much needed data to designs, which were the standards until forced draft changed the conditions.

It is also interesting to note that on a class of small gun-boats (nineteen in number), known as the "Chippewa class," forced draft was installed and regularly used. He took advantage of this opportunity to test the relative economy of evaporation with natural and with forced draft, and found that when the rate of combustion was increased from about 8½ pounds of anthracite with natural draft to about 20 pounds per square foot of grate with forced draft, the evaporation per pound of combustible was reduced about 30 per cent.

It has been mentioned above that the engines designed by Mr. Isherwood during the civil war did not use a high degree of expansion. As a rule they cut off at about seven-tenths of the stroke, which as all engineers know, would give an excellent card from the engines, both as regards expansion and compression. It is to be remembered that the steam pressures used at this time were very low, and the Michigan experiments had demonstrated that, while for their particular conditions a cut-off at four-ninths was the most economical, the table given shows that a cut-off at seven-tenths differed very little in economy. It is to be remembered that in naval machinery there is a feature which is of just as great importance as economy, if not greater, namely, weight. The advocates of extreme expansion seem never to have considered this point, but it was one which Mr. Isherwood realized thoroughly and which he frequently discusses in the "Experimental Researches." It has frequently been remarked despite what has just been said that Isherwood's engines were extremely heavy, and this is true considered from a purely academic standpoint. The great engineer, however, is not the man who designs machinery simply in accordance with the rules in text books, but the one who comprehends all the conditions which he has to meet and meets them successfully. This Isherwood did in a marked degree. Many years ago I had the pleasure of hearing Mr. Isherwood discuss this very point, and his reasons are conclusive. It was much more necessary that the engines should never break down than that they should be of the lightest weight consistent with ordinary design. The immense expansion of the American navy during the civil war necessitated utilizing the services




U. S. S. POWHATAN.

The most reliable and fastest ship of the old navy of the United States. This ship formed one of Commodore Perry's squadron which opened Japan to the commerce of the world.

of a vast number of engineers who, while men of natural ability, were in many cases without previous experience. To have put machinery designed for lightness in their hands would have resulted in many cases in break-downs. Something of the same comprehension of all the details applies to the machinery of the Wampanoag. These engines were of the geared type, the engine shaft making less than thirty revolutions per minute, while the propeller shaft made over sixty. The reason for using this type of engine, which, course, was very heavy, was to prevent the destruction of the light wooden hull by the racking strains which would have been brought about by a direct drive of the shaft.

It has been mentioned that Isherwood investigated the subject of superheating, and the undoubted economy resulting from this method of working was established. It was to some extent used in American naval vessels, and the Wampanoag had a few single-furnace boilers which were known as superheating boilers. Superheating was tried also in the merchant service, but the *rationale* of boiler corrosion was entirely misunderstood at this period and the means to be adopted to prevent it were not properly comprehended. As a result the rapid destruction of the superheating apparatus by corrosion caused the abandonment of this otherwise valuable feature from the standpoint of economy.

Steam jacketing is as old as Watt, and, like expansive working, is included in the specifications of his patent of 1769. It was not, however, until after the period which we are now considering that jacketing was used to any great extent. The low steam pressures and limited range of expansion did not cause enough liquefaction to make the use of jackets show any marked economy.

One most important feature as regards economy was, however, introduced during the latter part of the simple-engine period, namely, the surface condenser. The early marine engines used jet condensers exclusively, and, as can be readily understood, this was equivalent to using feed water of the same degree of saltness as the injection water. With salt feed water there was, of course, a steady deposit of scale on the heating surfaces of the boiler, and this was a hindrance to higher steam pressures, thus acting to prevent an increase of economy. The use of salt feed had another distinctly uneconomical result, from the fact that owing to a misunderstanding of the *rationale* of scale formation a practice was followed called "blowing-off," the idea being to blow out of the boiler a certain percentage of the more concentrated water, which was replaced by the incoming feed. This loss was as

great in some cases as 10 per cent., or, in other words, 10 per cent. of the heat imparted to the water was thrown away.

When the surface condenser was introduced the feed water was, barring leaks, fresh, so the blowing-off was stopped almost entirely and the loss prevented. As the incrustration was also prevented, there was no longer the fear of increased pressures on the ground of overheating the boiler surface, so that steam pressures immediately began to increase, accompanied by an increase in the ratio of expansion, with accompanying increase of economy.

It may not be out of place to say a word in this connection about the true explanation of scale formation when using salt feed. The principal ingredient in boiler scale from sea water is sulphate of lime, although this forms a very small percentage of the salts dissolved in the sea water. The old idea was that, like all other salts, this one would be more soluble in hot water than in cold, and it was supposed that the precipitation was caused by the evaporation and concentration of the water in the boiler. As a matter of fact, sulphate of lime forms an exception to the rule that most salts are more soluble in hot than in cold water, and it becomes almost insoluble when the temperature has risen to about 290 degrees Fahrenheit. This temperature corresponds to a steam pressure of about 45 pounds above the atmosphere, so that it will be seen at once that when pressures had risen to 45 pounds nearly all the sulphate of lime in the feed was deposited by mere elevation of temperature, and so far from blowing-off reducing the amount of scale, it simply increased it, because it necessitated a further supply of feed containing additional sulphate of lime. At the present day, when only fresh water is fed into the boilers, we no longer have the problem of scale on the fire heating surfaces, but special boilers, called "evaporators," (in which steam from the boilers going through a nest of tubes is the heat-carrying medium), are the only ones using salt feed. They are so constructed that the tubes are in nests which can be removed with great facility and very readily cleaned so that the scale in them gives no trouble.

It was mentioned above that one reason for the failure to adopt superheating in these early days was on account of the corrosion of the superheaters, and it may be as well to speak of the subject of boiler corrosion here, because, while the use of surface condensers obviated the difficulty from scale, simultaneously with their introduction there began great trouble from boiler corrosion. With that blind method of reasoning, which is not confined to engineering by any means, it was at once concluded that because two things happened at the same time

one must of necessity be the cause of the other, and it was therefore assumed that the surface condenser had caused the corrosion.

The fact was that under the old regimen, when all the interior surfaces of the boiler were covered with scale, there was no chance for corrosion. When the use of the surface condenser left the boiler heating surfaces clean there was nothing to prevent corrosion occurring unless great care was taken to prevent it, and, as a matter of fact, the regimen adopted was absolutely certain to cause corrosion. All sorts of reasons were given to explain the occurrence. One theory was that the copper tubes in the condenser and the iron of the boiler formed poles of a gigantic galvanic battery, and iron being the electro-positive metal was the one to be corroded. Still another explanation was that the oil used for lubrication was decomposed with the formation of fatty acids which attacked the iron.

Still another explanation charged the corrosion to electricity, plainly without any attempt to explain how. The truth is that it was the treatment with the boilers received which caused the corrosion. It was the custom, particularly with naval vessels, where the corrosion was most marked, when a vessel arrived in port to blow all the water out of the boilers, and, after the steam had condensed, to take off the man-hole plates "to let the boiler dry." The researches of the chemists have shown that the active agent in corrosion is the carbonic acid of the atmosphere, which, in the presence of moisture and oxygen, forms compounds with the iron which are unstable and after formation break up, leaving the carbonic acid free to continue its work. Now, as will be seen, the treatment of the boilers left the surfaces moist and provided ready access for circulation of air so as to insure the presence of all three of the necessary agents. The truth about boiler corrosion was not discovered until a later period than that which we are now considering, but it may be said that what was known as the Admiralty Boiler Committee of Great Britain made an elaborate investigation of the subject, and in 1878 submitted a report which pointed out the true state of affairs and gave the remedy. This was to keep the boilers, when not in use, full of water made slightly alkaline, or, if practicable, to have the boilers thoroughly dried and provided with trays of unslacked lime to absorb the moisture. Since boilers have been treated with care and intelligence their life has been very much greater than in the old days, when they were, while ostensibly cared for, really neglected and abused.

The illustrations in this article, with the exception of the first, are from the excellent "History of the Steam Navy of the United States," by courtesy of the author, P. A. Engr. F. M. Bennett, U. S. N.

# EMOTION AND REASON AMONG BRITISH WORKINGMEN.

*By Percy Longmuir.*

**Speaking as an Englishman, but possessing a thorough knowledge of industrial conditions on the Continent and in the United States as well, Mr. Longmuir touches a vital point when he emphasises the close relation which exists between emotion and popular opinion among British workmen. The need for the substitution of reason for the mere influence of emotion is well brought out in his thoughtful words, addressed to workingmen of his own as well as of all lands.—THE EDITORS.**

IN a former article on "The Home Environment of British Workingmen," social, educational and workshop limitations were discussed; in the present one I propose to examine the effect of emotion on industrial lives. The subject may be viewed from many standpoints, and the construction of any one view will naturally vary with the viewpoint; therefore an effort will be made to examine general effects and to avoid as far as possible all side issues. At first glance, the idea of an emotional environment in mill, forge, or foundry practice seems absurd and altogether out of place. What can be more prosaic than rolling mill or forge conduct of today? And yet the means taken to effect successful conduct of any department of industry depend to a vast extent on human units, subject in large measure to emotional feelings and passions. One effect of an exercise of unrestricted emotion is for a time to retard progress and to hamper invention. Many an industrial innovation has had the hostility of the workers to fight, not a few have had the combined hostility of masters and men to combat, before meeting with just recognition; and there are on record struggles of exceptional keenness between new methods on the one hand and combined or vested interests on the other. The cotton industry and the steel tradeoffer examples of such conflicts and these in turn give as much material for study and digestion.

In examining the extent to which emotion replaces reason, the effect on the industrial class only will be considered. The average British workingman believes that because he is a Britisher he is industrially superior to the workmen of any other nationality, and the very fact of being so places him in a position unassailable by any foreigner. Therefore when he hears of foreign competition, or by chance reads an article on it, he scorns all the facts of the case and

shelters behind time-worn excuses or time-honoured unbelief. American ship-building or locomotive making, German electrical-engineering—are to the majority myths or fables, and in the comparatively few cases where they are acknowledged to be worthy of notice it is only half-heartedly and with a qualification that British workmen are taking the chief share in such foreign enterprise. To have hitherto led the van in the progressive march is no guarantee that we always shall do so, but the effect of this leading has been to instil into industrial minds the fixed idea that this position is permanent and is as the laws of the Medes and Persians, which altereth not. This assumption is not based on thought or knowledge; it is formed without any study of either current events or of the annals of our own glorious past. The records and lessons of that past are a sealed book, the sole idea at present being that we Britons as a nation have always been first, and owing to the supreme fact of being British always will be so, as though the accident of birth were always to determine racial priority. Natural advantages of other countries are ignored, and the only thing acknowledged is in a broad manner that the success of Britain's competitors owes its first inception to British labour. National tradition is a stimulating and inspiriting force. It is the backbone of a patriotic constitution and as a force alone will in cases of emergency move men to superhuman effort. But of what use is a national tradition in the form of a hazy notion of superiority, with no conception of what has been, of what now is, or of what will be the essential features in this scheme of superiority? Did we but recognise the truth of the saying current in the sixteenth century:

"Our fathers that had more wit and wisdom than we."

and act upon it, then there would be comparatively little need to talk of an emotional environment as a factor of industrial matters. If we, as workingmen, studied "our fathers" earnestly and with strenuous endeavour tried to grasp the lessons of their industrial lives, then, and then only, could we take a share in the pride of the achievements and glories of a bygone age. This pride, founded on knowledge and associated with the moving spirit of the age, would contrast very strangely with the present hysterical emotion based on ignorance, formed without judgment, and believed in with the most implicit faith by multitudes of the working classes. Industrial workers are, however, not alone in this respect. A comparison of passing events will show that similar mistakes are repeated generation by generation, with most faithful accuracy and often painful results, by other classes

presumably acquainted with historical facts. National tradition, then, if it teach anything at all, should give us in addition to a just and proper pride, also a fit recognition of the non-infallibility of average human judgment as represented in a collective nation. Given this true spirit of national pride, we could then hope and work for a continuance of national greatness. The efforts made for the maintenance of this position would be founded on actual knowledge, and in progressing, valuable effort and energy would be conserved, not fruitlessly consumed in time-worn errors of judgment. This spirit, in full keeping with the progress of our own nation, would also be in sympathy with the advance of other nationalities; it would replace the present one of scornful, not to say hostile, indifference, with an eager desire to use all fair means as steps in the progress of national development.

Passing from national to more local types of emotion, we find it exhibited in many forms and various degrees of intensity. In its better aspects it may be seen in collections heartily and generously supported for the relief of some unfortunate fellow worker; equally impulsive, but not always so commendable, in the form of a sudden cessation of work by large numbers of men owing to some change in method of work, the introduction of a new tool, or possibly the appearance of a non-unionist amongst the ranks of the workers. Very insignificant changes often result in spontaneous outbursts of this kind; at other times the changes proposed have to be of a more drastic nature before resulting in an exhibition of this feeling. At any rate, it is certain that the depth or intensity of the emotion displayed on such occasions is not in any way proportionate to the change proposed, for usually the slighter the change, the greater the opposition it has to face. Emotional feelings are by their very nature extremely erratic, and in natures in which these feelings replace conviction it is difficult to estimate either their depth or intensity. Take, for instance, the case of an average manufacturing town possessing two prominent football teams, each of about equal merit, and examine the followers of these respective teams. Can it be said that they have thought out the merits or qualifications of either club and are therefore following and supporting a conviction? Hardly that—yet these very same supporters in thousands will follow and blindly swear by their own tin god to the exclusion of all reason or common sense. Saturday afternoons in any North-country manufacturing town of Britain fully demonstrate this assertion. It is the same, though possibly to a more temperate extent, with cricket—impulse, not choice, in most cases marks

out the path for the average individual to follow. Horse racing is perhaps a more typical illustration. In shop parlance, a man "backs his fancy" and let his knowledge of that particular horse be what it will, it is always on his fancy that his money is laid. The British workman is often accused of devoting more thought to sport than he does to actual work, and therefore these matters of cricket, football, and racing have been mentioned in order to show that on subjects on which he is so presumably thoughtful, it is still fancy or emotion which guides him.

Emotionalism degenerated into a pet localism is shown in town rivalry. A healthy spirit of rivalry may be conducive to progress, but the rivalry which persecutes a fellow workman because he hails from another town is a mean contemptible thing. "Can any good thing come out of Nazareth" expresses well this feeling of town rivalry. Observe the contempt in which Birmingham workers are held in the North. Ask a Clyde or North-East Coast brass moulder what his fellows in Birmingham chiefly produce, and he will in all probability reply "soldiers' buttons." On the other hand, these "button makers" have an idea that their *confrères* of the heathery land are in very fact northern barbarians. This spirit, due entirely to accident of birth and environment, is greatly rounded off by travel and work in other towns. A man who has worked in three or four localities is—other things being equal—of a far more developed type than one who has never been beyond the conditions into which he was born. In all cases a sharp distinction must be drawn between just pride in either a town or a well thought out cause and a hysterical emotion founded on air bubbles.

It naturally follows that the emotional balance of an industrial mind is determined by various simple and complex causes. We have seen the effect of inclination, whim or fancy in the case of recreations, and these factors are none the less powerful in the case of industry. Apart from these, daily occupations, especially when of routine character, tend to fix the emotions in a narrow groove. Under such conditions, accompanied as they so often are by narrow home surroundings, the outlook and scope are limited and the narrowing effect is seen in violent opposition to change or advance. This limitation of outlook assures the individual that any advance must mean eventual scarcity of work and consequent misery to himself, and therefore acting according to his light he opposes that advance with all the blindness and obstinacy usually found when reason is absent. The policy of trades unionism may to some extent foster this view, but it receives

its chief development in actual suroundings and circumstances of the individuals themselves.

Routine occupations combined with monotonous and never-changing surroundings effectually develop and intensify pet localisms of the mind; mental effort becomes a weariness, perceptions are limited by environment, and emotional feeling settles all matters requiring the exercise of judgment or reason.

Political opinions, if honestly formed as the result of study and thought, would have an exceedingly beneficial effect. Within certain limits these convictions would broaden the minds, given a wider outlook, and assist in the formation of a truer estimate of the actual conditions under which we live. In such a manner political opinions could be utilised and trained in a purely educational spirit. Contrast this educational force as it might be, with political conduct as it is actually practised. We have leaders, so-called, pandering to the emotions and flattering the tender susceptibilities of the multitude. Leaders in the true sense of the word they are not; they neither lead, educate, train, nor direct, and they obtain recognition by a suitable handling of the plastic material of their constituency. It must be regretfully confessed that political as also trades-union leaders do not in any way rise to the height of their opportunities of directing opinion into legitimate channels of thought, and so training the workers to realise in themselves the best that their position can afford. At the same time, it must be admitted that a so-called leader can hardly, by the very nature of things, lead or guide; in most cases necessity compels him, if he wish to maintain office, to follow his flock—he simply voicing their demands. Hence leaders, instead of interesting their followers in vital matters and directing that interest to ever widening planes of thought, are compelled to play upon the excitement and at times the passions of their constituency. This exploitation of the excitable feelings is responsible for much backwardness, it hampers education, retards advance, and to a large extent prevents our taking a leading part in the evolution of industry.

Times change, new facts are observed, scientific discoveries are brought within the reach of practical industry, and methods of work are revolutionised by the research and effort of advancing pioneers. To what end all this diligent and painful effort, unless it be combined with the accumulated experience of the past and result in the advancement of our industrial army as a whole? It is for them, if they have their own and the nation's welfare at heart, to apply in all heartiness and sincerity the new facts of research and experience. According to

some sections of public opinion and of the daily press one would think that every advance made by another nation means a corresponding recession on the part of Britain. This is not necessarily the case; it denotes neither commercial decay nor yet growing inferiority on the part of British workingmen, but it is simply a necessary factor in the evolution of that particular nation making the advance, and as such must be recognized as a factor of national development. An ideal spirit would admire progress wherever found and irrespective of nationality; therefore let us in all honesty give credit when due. Of what profit is it to call into the hysterical emotion so often exhibited on occasions when contracts leave British shores? What possible good can come by so lifting up our voices in a world-wide wail? Let us keep our wailing for the closet, and in public life we will be up and doing, nerving every fibre to maintain present and create new positions of industrial or commercial utility. But in this nerving for the tension of a keen fight, every effort put forth must be wholesome and sound, and given a fair field and no favour we can leave those efforts to that supreme test of all—the survival of the fittest. And should it be found that other nations are more fit than we, then let us, pocketing a lesson with the defeat, in all manliness give them the credit of well-won victory.

But before such a spirit can be inculcated into the minds of our industrial workers, something almost approaching a revolution in the method of thought (or should I say, lack of method of thought) practised by them will be necessary. Crippling environment or circumstances that tend to warp the judgment and narrow the outlook of multitudes of our workers must undergo renovation or removal. It is an easy matter to suggest reform, but to effect it is quite another story, and therefore no elaborate schemes are here outlined and the suggestions are from a purely utilitarian point of view. As outlined in a former article, a thorough-going education continued to a reasonable age is essential. This education, not necessarily technical, is to aim chiefly at the production of a sound child, one who in after industrial life can apply his training in the resolution of cause and effect. It is to be hoped that the near future will see this or a similar system in operation for the children of the industrial classes of Britain. But there are many forces already existing, quite apart from evening classes or similar effort, which might be turned to beneficial account in the training of those beyond school age. The extent of emotionalism has in a limited manner been indicated; it pervades alike industry and recreation and the only antidote is a sharp return to actual matter of

fact. Let this return take place in matters of recreation alone and an improvement in public spirit will soon follow. Back to the facts of sport—discard professionalism and let class meet class on the levelling ground of cricket or foot-ball field.

The pluck and endurance of British nationality were not built up by spending all available Saturdays in watching paid professionals kick the ball. Can one imagine a better tonic for a week of dreary toil than some keenly contested outdoor game? And what more invigorating or better likely to assist in keeping that balance of mind for which we were once so famous?

Trades unions or political organisations offer wide scope for the development of an inteliigent interest in industrial or economical progress, national welfare and general topics of the day. Keep to solid facts, no matter what particular views may be taken, and instil into minds at present comparatively unoccupied a desire to be *au courant* with current industrial, political, and social topics, and emotion receives its death blow. Cultivate an interest in historical matters, especially industrial ones, and a just national pride will replace the present "Mafeking" sentiment that now passes as such. Let us in all things come down to current facts, endeavour to understand and grasp problems of our times, and such an understanding will keep us, while moving onward, firm on the bed-rock upon which alone true progress is based.

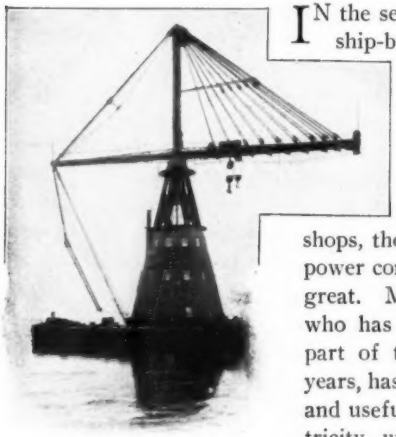
In this endeavour to keep to facts we have, in the just-completed Victorian period alone, a wealth of opportunity and assistance in its invaluable literature. These prophets, teachers, and thinkers are available to any working man in Britain today, and on his own shoulders rests the responsibility as to whether he take the chance or no. Many opportunities are to hand, let him rouse himself and grasp those within reach and then others are bound to follow. The first effort must come from the worker himself, and it is for this effort that the progress of British industrialism is now waiting. Will that effort be forthcoming?

Assuming that this effort be made, assuming that trades unions and other organizations take full advantage of their opportunities for education and that the various agencies at work create a body of industrial workers famed, apart from skill of handicraft, for their common-sense and balance—then in very truth the future holds for us in one respect at any rate a "thornless rose" and industrial progress and development are assured. But this thornless rose is based on assumptions which may or may not be realised.

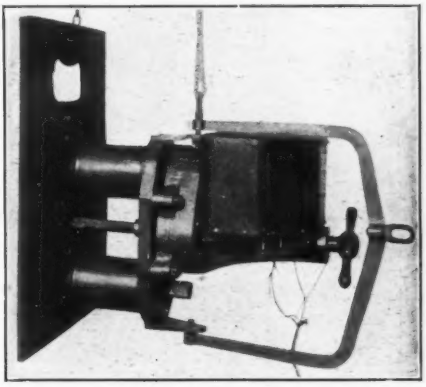
# ELECTRIC APPLIANCES IN SHIP-BUILDING YARDS.

*By Sydney F. Walker.*

**In a preceding paper, Mr. Walker discussed the general uses of electricity in ship-building yards and the driving of fixed tools and large apparatus. In this paper he takes up more particularly the smaller portable tools for operating on work *in situ*, the transporting machinery, and the generating plant.—THE EDITORS.**



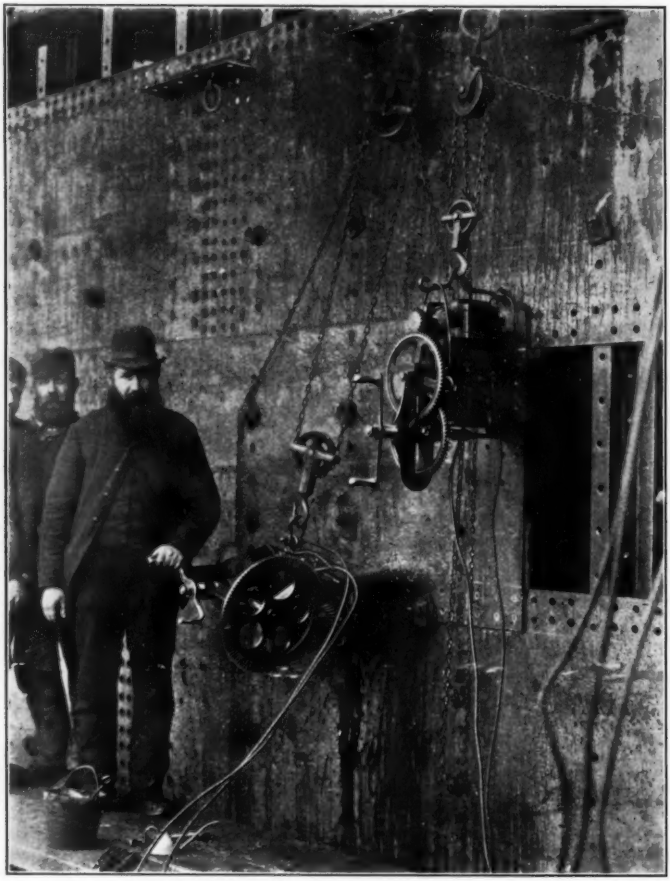
IN the second opening for electricity in ship-building yards—the operation of small tools designed to perform work upon the different parts of the ship *in situ*—there is a much wider scope than for driving the large machine tools in the workshops, though the aggregate amount of power consumed by these tools is not so great. Mr. F. J. Rowan, of Glasgow, who has given great attention to this part of the subject for a good many years, has produced some very ingenious and useful portable tools driven by electricity, which have been in use on the Clyde and in other districts for some time and have done good work. His electric drilling apparatus and electric rivetting apparatus, which are shown in the illustrations, were brought before the Institution of Mechanical Engineers in 1887, and were subject to a somewhat amusing criticism. Some of the speakers thought that it would be dangerous to employ electricity and magnetism in the manner proposed in the work upon the plates forming the side of a ship, as it would probably affect the working of the compasses when the ship took the sea. If the critics had known that to get a piece of steel to retain the magnetism which is put into it, for certain purposes, is one of the most difficult problems the electrical engineer has to deal with, their minds would have been quite at rest. In a case like this, where the electrical apparatus is being constantly moved about, a few inches at a time, any magnetism that might have been created would be instantly wiped



A PORTABLE ELECTRIC DRILL, ROWAN TYLE, DRILLING A PLATE SWUNG LOOSE.

out, even under the worst conditions. In Mr. Rowan's apparatus, the electromagnet is very ingeniously made use of to hold the tool in its place against the work it is operating upon. As will be seen from the illustrations, the apparatus consists, both in driller and rivetter, of two distinct portions held together. An electromagnet, with its two poles free, holds the tool against the plate or bar to be drilled, the work itself forming the armature of the electromagnet, or, in modern parlance, completing the magnetic circuit, while the electric motor, which is held by the same framework which holds the electromagnet, turns the drill through the usual gearing. With the rivetting machine, there are two variations of this arrangement. For rivetting, the tool not only requires to be held firmly on the work that is being done, but the work itself requires to be held together while the rivet is being made secure. For this purpose Mr. Rowan has again adopted very ingenious means. He provides two electromagnets, one in the same position as with the driller, on the side of the rivetting tool, the other on the opposite side, where a workman would be placed in hand rivetting to hold up against the hammer. The effect of the two electromagnets with the plates between them is to hold the two plates or bars very closely together, and this position can be maintained until the rivet has cooled sufficiently not to alter in position after the plates are released. It is claimed that rivetting by percussion is quite as effective as by pressure, as in hydraulic rivetting, provided that the plates or bars are held together in the position in which the rivetting has been performed until the whole has cooled.

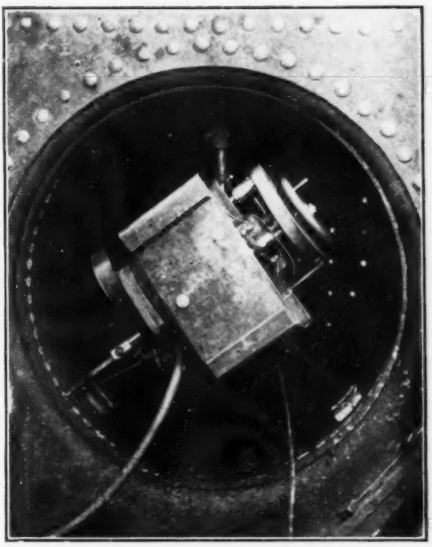
In the early form of rivetting apparatus, Mr. Rowan provided a strong spiral spring, which was wound up by the electric motor and which struck the blow, the winding up and release taking place in rapid succession, according to the number of blows required per minute. Machines are made on this plan slightly modified now, but Mr. Rowan prefers to use either compressed air or steam for the striking



TWO OF ROWAN'S ELECTRIC DRILLING MACHINES AT WORK ON A SHIP'S SIDE.

mechanism, a cylinder and piston being arranged for the purpose as shown in the illustrations, and to use the electric current only for holding the tool in its place. He is also enabled by this arrangement to work the rivetting tool at any angle, so as to take the head of the rivet under all conditions, and notwithstanding the inaccuracy of the holes punched. It will be seen what a very useful adjunct to the machine tools in ship-building are light portable tools of this description. Punching, as mentioned above, is often inaccurate; holes often require

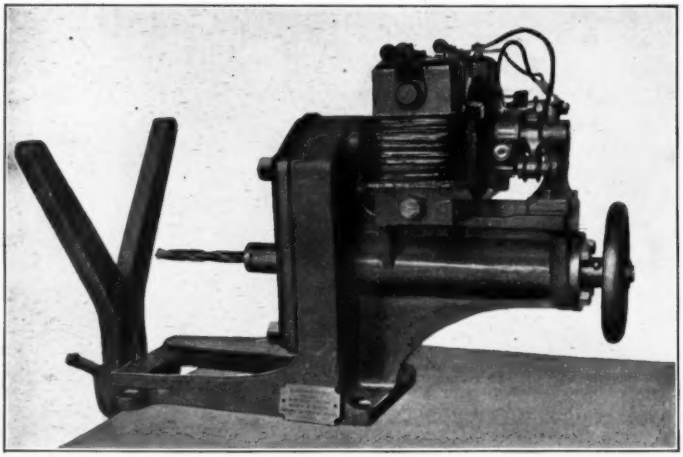
to be drilled in all sorts of positions where it is very difficult to get machines to work, and where hand labour would cost very high owing to the awkward position in which the man would be working. With this apparatus, holes can be drilled or rivetting, etc., can be performed in any position. The illustrations show the operations of drilling the inside of boiler flues and also the outside of ship plates. With the same apparatus, slightly modified, caulking is performed by a wheel, the wheel acting under pressure.



ROWAN'S PORTABLE ELECTRIC DRILL AT WORK INSIDE OF BOILER FLUE *in situ*.

A somewhat similar tool, of the portable variety, is that shown in the illustration; it is for cleaning up castings by means of a travelling emery wheel. This apparatus can be held in any position where it is required to work upon iron or steel, in any part of the ship, and can also be used in the machine shops. As will be seen it is driven by an electric motor.

Other portable tools, electrically driven, are shown in the drawings. Notable is the electric deck-planing machine, arranged to be wheeled about on a hand truck, similar to those used for carrying sacks of corn, coal, etc. The motor and gearing are contained in an iron box, the cutting knives being underneath, driven by transmission at the side, from the electric motor pulley. On the handles are also fixed the starting resistance and switches, so that the workman using the tool has everything convenient; he can stop or start the machine at will, and he just runs it over the deck surface as he might a sack of coals, but with less exertion and with greater care to see that he is planing all right. Another very useful class of portable tools of which there are many on the market are the portable drilling machines, of which specimens are shown in the illustrations. The arrangement is practically the same in all cases, with variations in matters of detail.



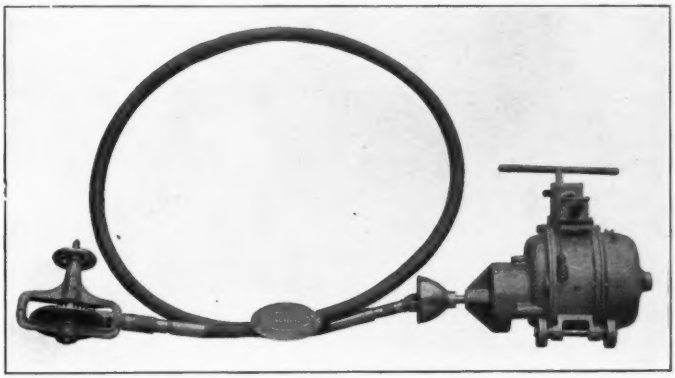
ROWAN'S PORTABLE ELECTRIC DRILL AS APPLIED TO WORKSHOP USE.

An electric motor is mounted on some sort of barrow or trolley, with handles by which it can be run about. To the shaft of the motor is attached either a flexible or telescopic shaft, and this is connected to the drill, the latter being held in some form of vise which also holds the drill up to the work.

The third portion of the useful work done by electricity in ship-building yards consists of the transporting and lifting apparatus. Cranes are in use all over ship-building yards, and they are now nearly all driven by electric motors, when once a power station has been installed. In a large number of cases the old steam cranes have merely had their steam engines removed, and single electric motors substituted; but wherever new cranes have been put in, the flexibility of the electric motor, which was referred to above, has been taken advantage of and three motors provided, one for the hoisting and one for each motion of the crane itself. Electric cranes are usually now provided, sweeping the whole length of the building shed and the whole length of the machine shops as far as the presence of belts and shafting will allow, and as belts are done away with by the continued subdivision of the driving, the overhead crane, electrically driven, more and more reigns supreme. Foundries and other places of which there are many where ship-building operations are progress, where heavy weights have to be lifted and transported, also have overhead cranes, electrically driven. About the ship itself, while in progress, are many

smaller cranes, winches, and capstans, which are now being electrically driven as shown in the illustrations, all that is necessary being the removal of the steam engine and the fixing of the motor and gearing.

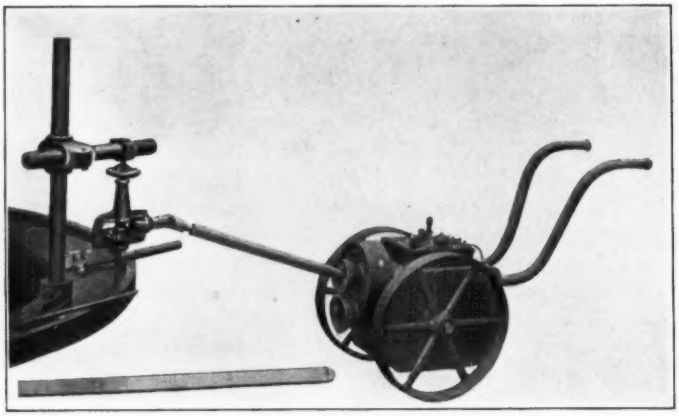
Electric locomotives do not yet appear to have taken their place in ship-building yards in Britain, but doubtless they will follow. The arrangements necessary for taking current from overhead trolley wires will be inconvenient at first, and managers will naturally be chary of having naked wires with 500-volts pressure alive about the works; but as the men become accustomed to the presence of electrical apparatus, and learn to respect high pressures, it will be possible to use many apparatus that are now impracticable. The development of the elec-



PORTABLE ELECTRIC DRILL WITH FLEXIBLE SHAFT.
Greenwood & Batley, Leeds.

trical accumulator also will enable electric locomotives to be employed without these dangers.

There are several other apparatus in which electricity is employed in ship-building yards. Pumps for the dry-dock, which is a part of the modern ship-building yard, are driven by electric motors, and also pumps for the boilers and for various other purposes. The lighting plant in most modern ship-building works is also electrical, arc lights being freely used about the yards, with incandescent lamps in positions where arc lamps are impracticable; and it is a striking illustration of the development of the use of power distribution by electricity, that instead of driving the lighting generators by separate engines, they are in many cases driven by electric motors from the main electric-power service. Practically, what is done is this:—motor-generators are put down, taking their current from



A PORTABLE ELECTRIC DRILL WITH UNIVERSAL-COUPLED SHAFT.
Mavor & Coulson, Mile End, Glasgow.

the supply service, at the pressure and in the form ruling, and delivering it to the lighting circuits in the form required for them. This is again a striking illustration of the flexibility of electricity. At present, if an electrical engineer is given an electrical plant in any form and he is also given what other plant he asks for, he can produce current in any form that may be required, in any place, within very wide limits.

But perhaps the most striking feature of the advance by which electricity is pushing its way into every branch of engineering is the fact that it is actually employed as part of the plant in connection with compressed air, and with water-worked apparatus. Where an electric power service exists, it is frequently employed to drive the air-compressing plant supplying tools and other apparatus using compressed air. And in one case at least it is employed to pump water for a hydrostatic tool, as shown in the illustration of the hydrostatic press made by the Niles Tool Co. The hydrostatic press is an apparatus employed to force wheels and similar pieces of apparatus upon the shafts or axles on which they are to run. In ship-building it is employed to force the crank onto its shaft, in those cases in which the crank shaft is not made from one forging. The crank portion is placed in a rest, a holder provided for it where it is held firmly, and the shaft is forced into the aperture made for it in the end of the crank, by means of a ram worked by a piston with water pressure behind it. The water pressure is produced by means of a pump carried

A PORTABLE ELECTRIC DRILL WITH FLEXIBLE SHAFT; TWO-PHASE MOTOR.

on the tool frame itself, the pump forcing the water, when required, from a tank below into the ram behind the piston. In the tool shown, the pump is driven by an electric motor. There is no reason why the pumps for the hydraulic service should not be driven by electric motors. It will be economical and convenient, and it will lead the way to the further change—the performance of all the work by electricity.

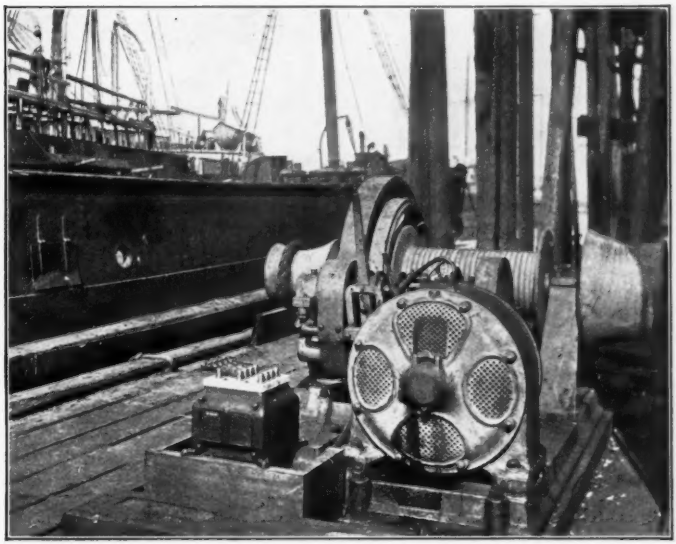
Another portion of the work of a ship-building yard, as well as of other industries that will in my opinion be done in future years by electricity, is the heating of the different portions of the ship—the

PORTABLE ELECTRIC RIVETTER AT WORK IN A CONTINENTAL SHIP-YARD.
Kodolitsch system. By courtesy of Mr. F. S. Dudgeon.

plates, bars, etc., which have to be heated before they can be bent to the required forms. The method at present employed is clumsy compared with electric methods, and though it will probably be thought by practical ship-builders the dream of a visionary, I have seen so many dreams come true during the last twenty-eight years that I have been engaged in electrical work, so many of the prophecies for which I have been roundly laughed at have become accomplished facts (and in many cases, in the hands of the very men who laughed,) that I have no hesitation in again venturing into the dangerous field of prophesy.

I believe also that the problem of protecting ship's bottoms from the action of sea-water will be solved, more effectually than it is now, by depositing the protecting metal upon the iron by electricity. There are, as in other cases, difficulties to be overcome in this matter apart from the practical difficulty involved in arranging the enormous depositing bath required for the purpose. Deposited metal is porous, unless hammered afterward; but this will be overcome as so many other difficulties have been during the past twenty-five years.

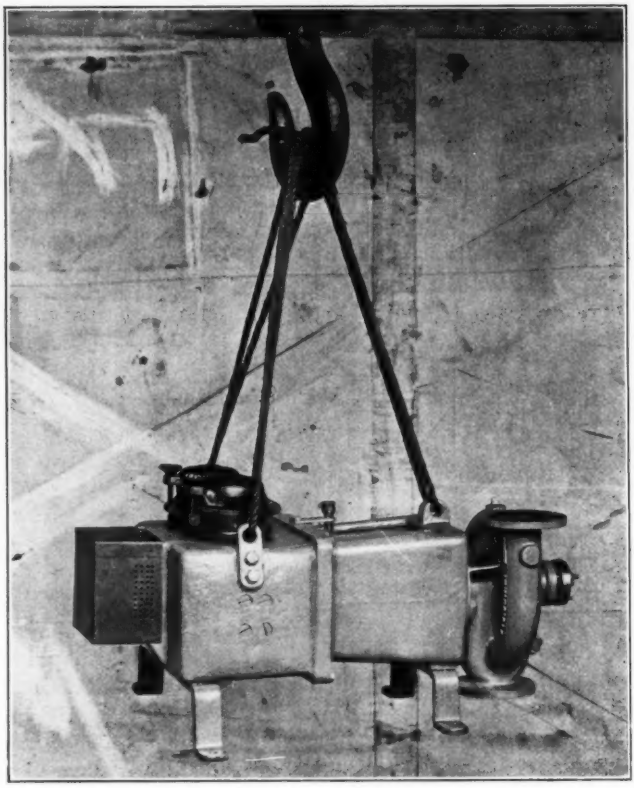
I believe that I cannot finish this article better than by describing



WINCH DRIVEN BY WESTINGHOUSE THREE-PHASE ELECTRIC MOTOR, PALMER'S SHIP-BUILDING YARDS, JARROW-ON-TYNE.

an installation of electric power that has been recently put in at the historic works of Messrs. Palmer, at Jarrow-on-Tyne. Messrs. Clarke, Chapman and Company and the British Westinghouse Company have carried out the installation together at the works of the Palmers Ship-building Company, the Westinghouse Company providing the larger motors, the switchboard, and some accessories, and Messrs. Clarke Chapman doing the work and supplying the remainder of the apparatus.

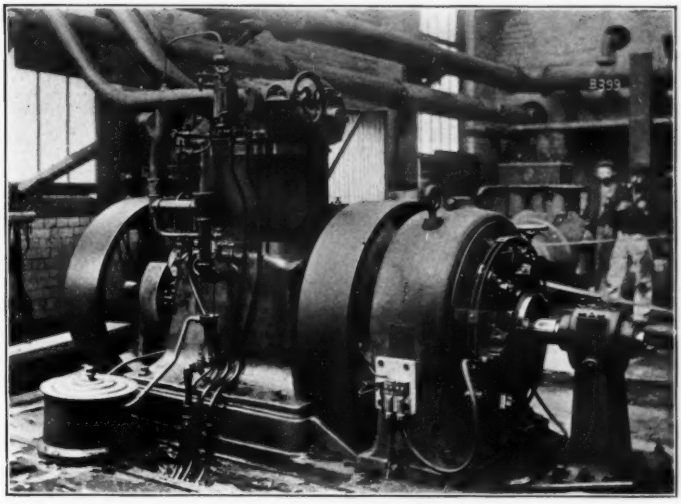
The installation is virtually a power station, as large as many central stations in large towns. The whole is carried out by means of three-phase alternating currents. Two Westinghouse three-phase generators, of 750 kilowatts output, are directly coupled to triple-expansion open-type marine engines of 1,000 horse power, the speed being 160 revolutions per minute, the electrical pressure 440 volts, the boiler pressure 150 pounds per square inch. Engines and dynamos are connected together by flexible couplings, and have flywheels 11 feet in diameter between them, the flywheels being carried by a separate set of bearings. The alternators are of the rotating-armature type, the field magnets consisting of twenty-two laminated pole pieces,



PORTABLE ELECTRIC PUMP FOR USE ON BOARD SHIP, DURING CONSTRUCTION.

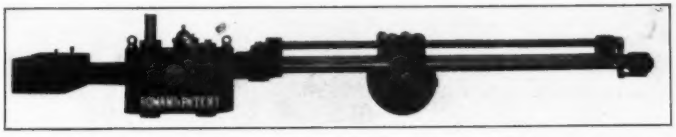
The apparatus consists of a small enclosed motor direct connected to a centrifugal pump, and may be slung into position as needed. Clarke, Chapman & Co., Gateshead-on-Tyne.

cast into a containing ring in the usual manner. Two continuous-current machines, driven by Westinghouse compound engines, provide the exciting current for the alternators. The exciter generators are of the same construction as the alternators, having six poles instead of twenty-two, and being arranged with commutators, and for continuous current instead of for alternating. A separate power house is provided, with the boiler portion divided from the engine and dynamo portion, as is now usual. One hundred and four motors are fixed, all of the three-phase induction type, in which the motion of the rotor is obtained by the revolution of the magnetic field round the outer con-

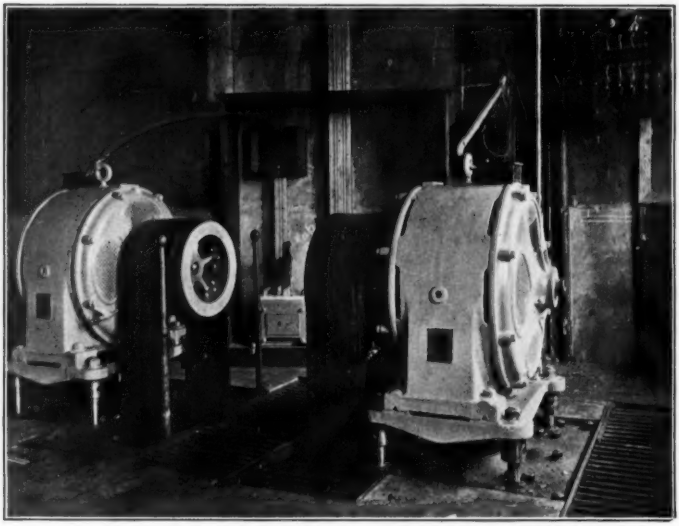


WESTINGHOUSE STEAM-DRIVEN EXCITING SET, PALMER'S SHIP-YARDS, JARROW-ON-TYNE.

taining ring. The motors are of the usual Westinghouse type, the smaller one, those of 20 horse power and below, being made by Messrs. Clarke Chapman & Co. on Tesla's patents, under license from the Westinghouse Company. The aggregate power of the one hundred and four motors is 1,750 horse power, and they are used to drive lines of shafting, large machine tools of various forms, cranes, winches, fans, pumps, and, in fact, to do all or very nearly all the work of the yard and shops that was previously done by steam conveyed to all parts of the works. Power is distributed to the motors by a system of three-cored cables, the individual cables being insulated by vulcanised rubber, braided over all and covered with lead. The major portion of the cables is laid underground, but a portion is carried overhead, and in that the lead covering is omitted, the completed cable being covered with marline. A five-panel marble switchboard is fixed in the power house, two panels for the generators, which can be run in



EMERY MACHINE WITH TRAVELING WHEEL FOR DRESSING LARGE STEEL CASTINGS.

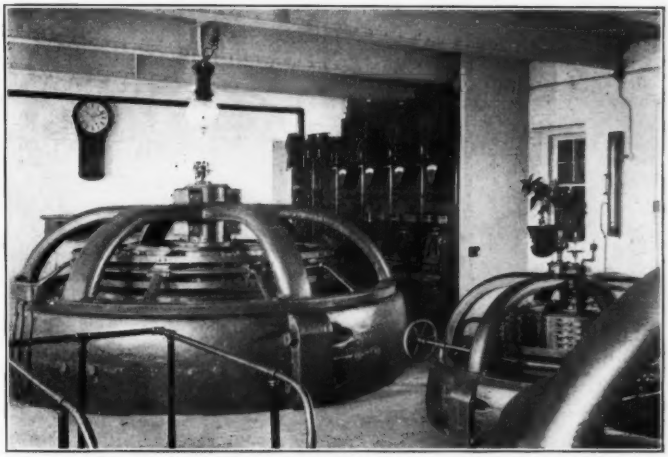


WESTINGHOUSE THREE-PHASE MOTORS OPERATING DRY-DOCK PUMPS, PALMER'S SHIP-BUILDING YARDS.

The pumps are below, and are belt-driven from the motors.

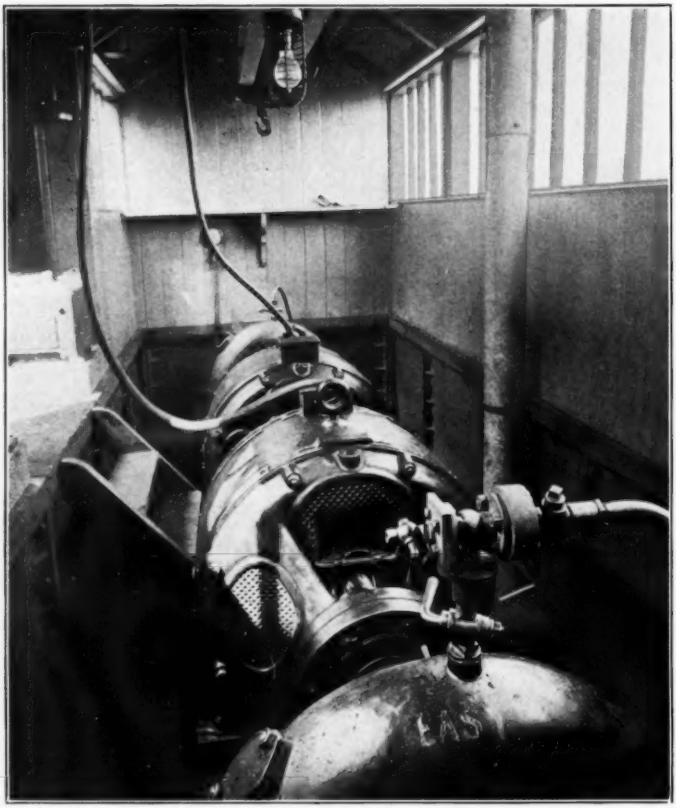
parallel or independently, two for the main cables, and one for the exciter circuits. From the main switchboard two main circuits are taken, each consisting of three cables, each of 0.33 square inch section. One main cable is taken to a main distributing switchboard in the machine shops, from which five branch feeder cables, of the same pattern as the main cables, are taken to branch distributing boards, and from these further cables on the same pattern are taken to the neighbourhood of the motors, where the starting arrangements are located. The other main cable is carried to a main distributing board in one of the sheds, from which eleven branch distributing cables are carried to as many branch boards, from which again branch cables run to the motors.

The starting arrangements are rather unique, and in my opinion calculated to get rid of some of the troublesome features attendant upon slip rings and switches for starting in dusty places. The supply current is led to a transformer box, upon the face of which is what Americans call a throw-over switch (Englishmen call it a two-way switch), arranged to handle the three-phase current. When in one position, a transformer is in circuit with the motor, which reduces the



ELECTRIC MOTORS OPERATING PUMPING PLANT FOR DRY-DOCK.
Newport News Ship-Building & Dry-Dock Company, Newport News, Va.

150-TON ELECTRIC REVOLVING CRANE, NEWPORT NEWS SHIP-BUILDING & DRY-DOCK COMPANY.



WESTINGHOUSE THREE-PHASE MOTORS DIRECT-COUPLED TO CENTRIFUGAL PUMPS, PALMER'S SHIP-YARDS.

pressure so that the starting current in the rotor is not excessive, and when in the other position the supply service is directly connected to the motor. The connections are made from the supply service to the autostarter, as it is called, and from the autostarter to the motor. To start, the workman has only to throw his switch over, and as soon as the motor has got up speed, to throw it back.

The arrangements at the switchboard are very complete. Each distributing board has a main entry switch and fuses, as well as the branch switches and amperemeters in all circuits. No break or joint is made in any cable. The periodicity is 30 cycles, and the motors

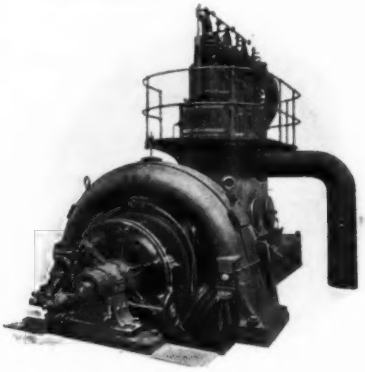
ELECTRIC DRIVEN WINCH, PALMER'S SHIP-BUILDING CO., JARROW-ON-TYNE.

Westinghouse three-phase motor direct-coupled. The winch is installed where needed and used in lifting portions of the work under construction.

range from 5 horse power up to 50 horse power. In this installation the lighting service is worked by a dynamo driven by a motor taking current from the power service.

It may be interesting to compare this installation with one recently put in at the navy yard in New York. In this installation, the plant, which was also put up by the Westinghouse Company, though in this case of America, is of 1,200-kilowatts capacity, and consists of three

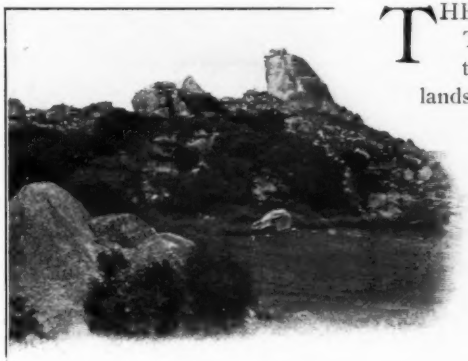
two-phase alternators each of 400-kilowatts output, driven by cross-compound vertical condensing engines, running at 136 revolutions per minute. The boiler pressure is 160 pounds per square inch. The generators deliver two-phase currents at 220 volts and 25 cycles. The distributing cables are rubber and lead covered. The motors are all two-phase induction, and range from 200 horse power down to 5 horse power. In addition to one motor of 200 horse power which drives an air compressor, there are two of 100 horse power each. The cranes are fitted with direct-current motors, and to supply this, rotary converters are used, two of 75 kilowatts being installed. It will be seen that there are two differences between the English installation and the American, though in nearly every other feature they are exactly alike. In New York, motors up to 200 horse power are installed, while in Jarrow there is none above 50 horse power, and while in Jarrow the pressure of the service is 440 volts, that in New York is only 220 volts. There is the other difference, in New York the current is two-phase, while in Jarrow it is three-phase, but this is hardly a difference; it is merely a matter of taste, or one of those differences which run through all engineering. The other two differences, though, mark the trend of thought on the two sides of the Atlantic. American engineers are allowed to go faster in the matter of the quantity of power to be entrusted to an individual motor in work of this kind; but while American practice has been in so many cases to use high pressures, where English feeling his been against high pressures, it is very significant, that while in Britain we are prepared to go to higher pressures, on the American side, both in marine work and in mining work, the tendency is to lower the pressure.



# THE RAILWAY REORGANISATION OF THE TRANSVAAL.

*By A. Cooper Key.*

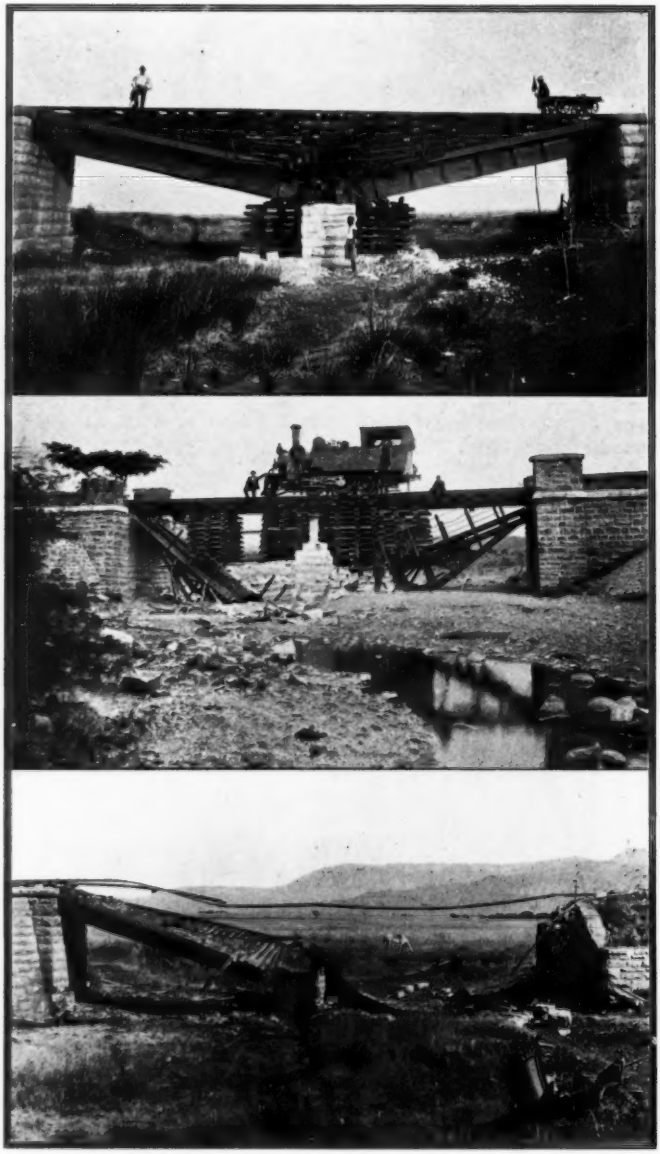
**With the return of peace and the restoration of order in the Transvaal, the reorganisation of the railway system and the regulation of traffic upon sound business principles become questions of the highest importance. Mr. Cooper-Key writes of his own intimate knowledge of past conditions upon the railways of South Africa and his judgment as to the policy to be pursued in the future is sure to attract interested attention.—THE EDITORS.**



A typical South African Kopje.

THE railway system of the Transvaal consists of the lines of the Netherlands South African Railway Company and the Pretoria-Pietersburg Railway Company. In addition to these is the Selati Railway (Komati Poort to Leysdorp) of which about 70 miles have been completed, but upon which no traffic has been carried. For all practical purposes, the Transvaal system may be taken as comprising simply the lines of the two administrations named above, at one time operating 717½ and 178 miles respectively.

A very important feature in connection with the South African Railway system is the policy to be pursued with regard to these two railways, and especially the Netherlands Railways. No need here to tell the history of that company, of its extortionate freight rates and passenger charges, how it fleeced the mining industry, how it increased the cost of all supplies. The administration of the Netherlands Railway as it existed in the past must be entirely changed. As a temporary measure the lines have been taken over by the Imperial military authorities. But what in the future when the country has settled down to civil administration?



THREE EXAMPLES OF THE DESTRUCTION OF BRIDGES BY DYNAMITE.

The uppermost and lowermost are over tributaries of the Waschbank, the upper one showing the method of repair adopted by the military engineers. The middle one is at Nelthorpe.

By courtesy of *De Ingenieur*.

KAFFIRS BOOKING AT PRETORIA.

For years before the war, the government of the late South African Republic had been urged, not only by the leaders of the mining industry, but by the more enlightened and patriotic section of the Raad, to expropriate the Netherlands Company. But as this was a step in progress and reform, the real rulers at Pretoria refused to carry out the scheme. It is true the matter of expropriation was frequently discussed, but still the monopoly remained. The purchase of the railway would have brought the country a large revenue and would have relieved the mining industry of what was undoubtedly its greatest burden. But like the dynamite monopoly, the railway was "a corner stone of the country's independence" in Mr. Krüger's estimation. The whole fabric of independence has collapsed, the corner stone is among the ruins. One word to indicate how outrageous were the company's charges, and how severely this affected the mines. The Industrial Commission which sat in 1897 advocated a gross reduction in rates amounting to £500,000 yearly. Undoubtedly this commission handled the company very tenderly. When, however, its report was considered by a Raad committee, all its recommendations were whittled down to such an extent as to be practically of no avail, and this latter body was of opinion a reduction of £200,000 would meet the just demand of the mines!

The Concessions Commission at Pretoria has been investigating the case of the Netherlands Railway. How hopelessly the company has compromised its position by the doings of its officers during the war

A SOUTH-AFRICAN RAILWAY CUTTING.
At Vygeboompoort, Pretoria-Pietersburg Line.

has been admitted by one of the principal administrators. Will the British government expropriate the concern? A policy of acquisition will no doubt prove the soundest.

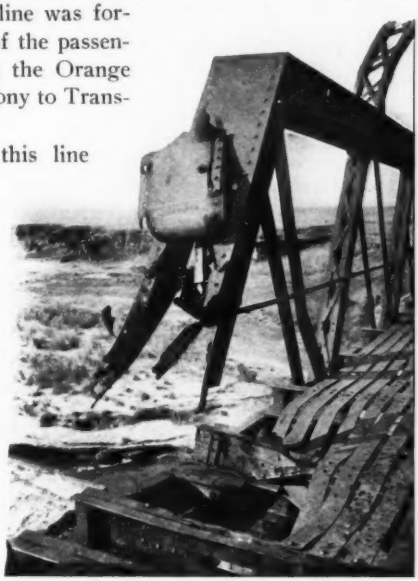
In South Africa government ownership of railways has been considered far preferable to private proprietory. Of course, the Netherlands administration has been the chief cause of the unpopularity of the latter system. Whether railway companies run equitably and on British lines would be satisfactory from a public standpoint is another matter. Even that seems questionable. It is virtually impracticable to have any competitive system of railways in the two new colonies. And without competition, would it be going too far to say that private control could never be altogether efficient and satisfactory? Why not fol-

NEW CARRIAGES AT PRETORIA STATION, READY FOR TRIAL TO PIENAAR'S RIVER, APRIL 27, 1899.

low the precedent of Cape Colony and Natal, in which colonies practically the whole of the railways are owned and worked by the government, to great and manifest advantage, both to the individual and the State?

Though in the present unsettled state of affairs one would hesitate to lay too much stress upon incidents, there appears to be some indication of a desire to fight the Netherlands Company on its own ground. Arrangements have been made to join the terminus of the railway system of the Orange River Colony at the River Vaal with an entirely independent line to Johannesburg, through the important though but little exploited coal field lying to the south-east of Krugersdorp. Indeed, the construction of the thirty-four miles of direct railway was one of the earliest works taken in hand after the British occupation of the Transvaal. This new line will supersede that of the Netherlands Company, which goes via Elandsfontein, forming there a junction with the lines to Pretoria and to the eastern extremity of the Rand. By this route the distance from the Vaal River to Johannesburg is no less than 51 miles. Upon the latter line was formerly conveyed the whole of the passenger and goods traffic from the Orange Free State and the Cape Colony to Transvaal stations.

By the completion of this line two distinct routes will be open from the Vaal to the Rand. For the western part of the Rand and Johannesburg, the new line will be the most direct, but for Pretoria and the East Rand the old line probably has a slight advantage in point of mileage, though this is set off by severe curves and gradients. The great bulk of traffic is of the "through" description, and the usefulness of these two lines (the old and the new) will be limited by the ca-



DETAIL OF THE FIRST ATTEMPT AT DESTRUCTION OF THE BRIDGE OVER THE WASCHBANK, SHOWING DAMAGE DONE BY DYNAMITE.

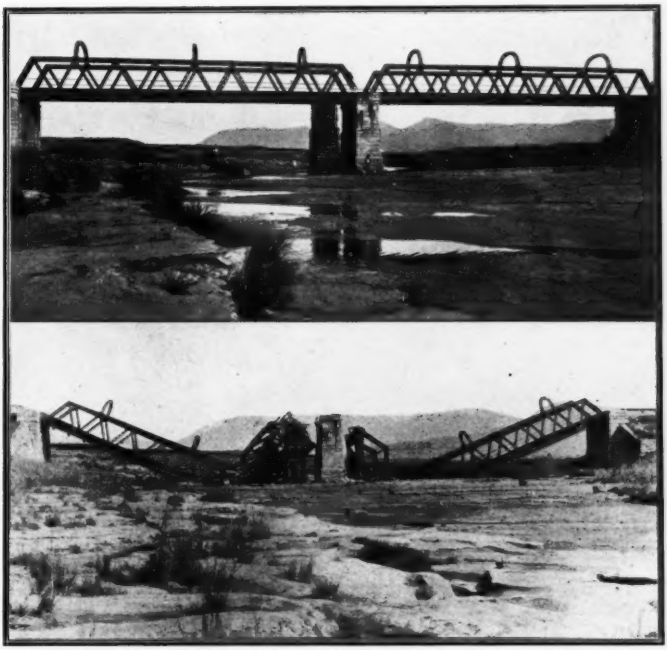
By courtesy of *De Ingenieur*.

PLATE-LAYER'S COTTAGE, HAMAN'S KRAAL, PRETORIA-PIETERSBURG RAILWAY.

pacity of the single line of railway through the Orange River Colony. There are, it is true, extensive coal mines at the Vaal River, the produce of which forms a heavy traffic. Hitherto this has all been carried southwards, chiefly for locomotive use on the Orange Free State and Cape Government Railways. Excessive rates have prevented these mines supplying the Rand, but even with reduced freight charges it is difficult to see how they could compete with such mines as the Clydesdale, the Great Eastern, and the Cassel at Springs in the East Rand district so much nearer the gold mines, and with the partly developed Sypherfontein mine, which the new railway passes, the nearest coal mine to Johannesburg and to the mines lying west thereof.

The old line could be used for the mineral traffic some expect from the Vaal River coal mines, and for traffic to Pretoria, leaving the new and direct line available for passenger traffic and through supplies to Johannesburg and the Western Rand.

With regard to the traffic from the South, there is no doubt the Netherlands Railway could be fought. More correctly speaking, there is little fighting to be done; the new line has assured the victory. There are, however, other matters to be considered. For instance, there is the



BRIDGE OVER THE WASCHBANK RIVER, AFTER FIRST AND FINAL ATTEMPTS TO DESTROY IT WITH DYNAMITE.

The second effort was after the retreat of the Boers behind the Biggarsberg Range. Reproduced by courtesy of *De Ingenieur*, of The Hague.

question of the traffic and the line to Delagoa Bay—Lourenço Marques—the nearest port to Johannesburg. The Portuguese port is only about 395 miles from Johannesburg, while the next nearest port is Durban, 483 miles, and the nearest colonial port, Port Elizabeth, 715 miles away. Although the facilities for handling cargo at Lourenço Marques are practically *nil*, large quantities of mining material and other supplies have in recent years come into the Transvaal by this route. Indeed, the traffic has been fostered by the Netherlands Company charging preferential rates to the detriment of the Cape and Natal routes. In large measure this has been justified, as the company had a haul of about 340 miles, compared with about 170 for traffic ex-Natal Government Railways, and only about 50 for that coming off the Cape and Orange Free State systems.

Given adequate facilities for discharge of cargo at Delagoa Bay, (or rather Lourenço Marques,) there is no reason why this port should

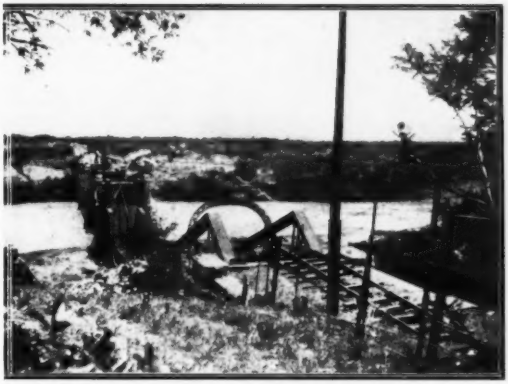
HAULING THE BOILER OF A 19-TON LOCOMOTIVE.
By courtesy of *De Ingenieur*, of The Hague.

not increase the hold it had upon the trade of the Transvaal. This opinion will be anything but palatable to those interested in the Natal and Colonial ports. And besides the advantage of geographical position—always an important factor in matters of this kind—regard must be had to political considerations. These two will in all probability prevent diversion of traffic—almost wholly "goods"—from Lourenço Marques to other ports.

It will be seen that the Pretoria-Delagoa Bay line is an important one. It would be in the last degree unsatisfactory to have it in hands foreign to the administration of other lines in the new colony. An alternative would be the construction of a new line from the Rand to Delagoa Bay, at at least an extension of the East Rand line from Springs towards Middelburg and so on to the seaboard. But this would mean the practical "paralleling" of the line from Middelburg to Delagoa Bay for a distance of from 150 to 200 miles.

Sentiment of course says "Never mind the foreign port, give all the trade of the new colonies to the British ports—Cape Town, Port Elizabeth, East London, and Durban." Put aside the question of the justice of this idea. Even if we allow its soundness, the acquisition of the Netherlands Railway appears advisable, if only to secure the 160 miles of track from Elsburg (a few miles south of Johannesburg) to the Natal frontier. To permit the Netherlands Company, as such, to re-

main would simply be sowing the seeds of endless complications. Naturally the company would not be content "to earn an honest penny"—we know enough of its past to be quite certain on that point. Where it could charge extortionately the opportunity would be seized. In the instance just mentioned, it would be unfair in the last degree for Natal traffic to be at the mercy of a company while the Cape Colonial ports were favoured with a State-owned route throughout. In such a case what would happen? The railway charges from the Cape Ports to the Transvaal and those from Port Natal to Johannesburg would be similar. The company if allowed to remain would grab the lion's share of the rate via Durban, leaving the Natal government lines with a modicum of profit. With that "half loaf" would they have to be con-



DESTROYED BRIDGE OVER THE TUGELA RIVER AT COLENSO.
By courtesy of *De Ingenieur.*

tent. Again, to leave the "reef-line"—the line along the mines from Boksburg to Krugersdorp—in the hands of a private concern of the type of the Netherlands Company would be a policy leading to endless friction. An entirely new line paralleling the old one would not altogether circumvent the difficulty.

It may be argued, has in fact been argued in certain quarters, that the actions of the railway officials during the war, and more especially the acts of destruction of railway bridges and plant in Natal and elsewhere, make the discussion of the question of expropriation a work of supererogation. Instead of "buying out"—"expropriation"—it is a matter of "seizure." Admittedly there is a great deal to be said in support of this view of somewhat drastic procedure. But would it be consonant with British ideas of justice and fair-play? For the members of the Hollander gang which blew up bridges in Cape Colony and

Natal in the rear of the retreating Federal forces no punishment is too severe. And such punishment must be meted out. But the punishment for their misdoings cannot be extended to innocent European shareholders and bondholders.

No just or valid objection could be made against the buying up of the Netherlands South African system at bed-rock prices. Whatever share the late government had in the railway must be reckoned spoil of war, and for such no payment would of course be made. Then again should be further deducted the value of the holdings of officials and others (chiefly Hollanders) who broke their neutrality.

Excluding the shares held by the government of the South African Republic, it may be stated that reckoning the outside shares as being paid off at par and the debentures at a premium of 10—the bonds bear 4 per cent. interest at the rates of 4.8 per cent. and 5 per cent. on different issues—the acquisition of the lines, rolling stock, plant, etc., could be effected for about £7,500,000. This works out at rather over £10,000 a mile including equipment—not an extravagant figure. It cannot be reasonably urged that the British government should take cognizance of, much less adhere to, the clauses in the original contract between the government of the late South African Republic and the railway company relating to expropriation. *Inter alia,* this provided that the shareholders should receive twenty times the average dividend of the three preceding years. As the company earned 13¼ per cent. on its capital in 1896, 12¾ per cent. in 1897, and 11½ per cent. in 1898, this form of valuation is entirely out of the question. The British government always deals fairly, can it be expected to deal tenderly with the proprietors of an organisation which has greatly assisted the Republican forces against her, though it was a Dutch concern with its head offices at Amsterdam?

During the last three normal years the Netherlands Railway made profits approaching £1,400,000 annually. If backed by Imperial guarantee there should not be the least difficulty, even in these days of dear money, in raising a railway loan of say £8,000,000 bearing interest at 4 per cent. For the service of this loan the sum of £320,000 would be required each year. A satisfactory sinking fund would be provided by setting aside £250,000 annually for debenture redemption. There would be still a large margin between these two items and the profit figures of the past. Rates and fees could be reduced by quite 50 per cent. with proper and up-to-date management. Moreover, even on that basis of reduction substantial sums could be provided for betterment of lines and stations and renewals of engine and coaching stock.

# THE NUMERICAL RECORDING OF SHIPPING AND MANUFACTURING ORDERS.

*By Kenneth Falconer.*

## THE CARD INDEX SYSTEM IN SHOP ADMINISTRATION.

The filing of letters, orders, and other commercial documents is a matter which should interest not only the office management, but also the works manager, especially with the introduction of modern methods of workshop accounting and cost-keeping in which each piece of work is made the subject of a separate record as it passes through the works. Mr. Falconer describes a system which has been found to possess many advantages in practice, and which should meet with the interested attention of managers and workshop accountants very generally.—THE EDITORS.

NY system for handling and recording shipping and manufacturing* orders, in addition to such requirements as are necessitated by special circumstances, should accomplish the following general objects:

The plan adopted should guard against the possible loss of an order after receipt at the order desk, or any unnecessary delay in transmission to the department interested; against the likelihood of neglect or oversight by the shipping department in the case of a shipping order, or by the factory office in the case of a manufacturing order; and against the risk of goods being manufactured and received from shops without advice as to what shipping order they are meant to fill, and so put into stock instead of promptly shipped. It should eliminate entirely the possibility of goods manufactured to fill a certain shipping order being shipped or delivered without proper charge therefore being made. In addition the system should enable those interested to refer without delay to the original authority, signed by the customer, upon which any shipping or manufacturing order has been issued, and to ascertain what portion, if any, of the goods called for has been manufactured or shipped and what balance remains uncompleted.

Completed orders should be filed in such way as to be readily obtainable, whether asked for by the name of the article manufactured

* Shipping orders—written instructions from the order to the shipping department to ship or deliver certain goods to a named party. Manufacturing Orders—written instructions from the order department to the factory office to have certain articles manufactured, or specified work done.

or of the customer for whom they were made, and to minimize the chances of being replaced in a wrong position after being referred to. Their arrangement should be such that all orders, whether the original received from customer or the shipping or manufacturing order issued from the order department, shall always be found in the same relative position one to another, and that comparisons with the previous manufacture or sale of similar goods, as regards cost, selling price, and profit, may be easily made, and any abnormal difference promptly seen and looked into.

Finally, these risks must be guarded against, and requirements met with the least possible expenditure of time and labor consistent with the results looked for, and the work so distributed that practically all the clerical part shall be done in the office.

To obtain these ends with a minimum of error and a maximum of efficiency, the numerical system of handling and filing may be used to the greatest advantage. It provides for each point and safeguard equally as well as the alphabetical, and at a less expenditure of time, while for convenience in filing and referring to orders and papers, a comparison is very strongly in its favor. For example; one knows instinctively the correct relative numerical positions of three cards numbered 25, 26 and 27—where to file them or to look for them, as the case may be. If instead of numbers the name is to determine their relative positions, and they are headed respectively:—The Robinson Tool Co., Thos. Robinson & Co., and T. J. Robinson—their correct alphabetical arrangement is not so easily and readily determined. In other words, when the numerical system of filing is in use the factor which decides the position of any card or paper (i. e., the number) always indicates exactly such position. With the alphabetical system, the determining factor (the name) only approximately indicates the correct position, and even this may be largely affected by peculiarities of spelling indulged in by the writer of the name. Supposing the name unfamiliar and the sound the only guide; papers referring to Chas. Magee might be written and filed or looked for under McGee, Macgee, or Magee. If, however, Chas. Magee is represented by, say, number 126, there is little likelihood of any paper bearing such number being placed in a wrong position. The numerical system once adopted, numbers become as familiar as names, and are quite as easily remembered.

The base of the system here described is a conversion of names into their corresponding numbers at the order desk, and thereafter their arrangement and classification according to such numbers.

To accomplish this, the order clerk is provided with a number register and a card index. The former is a book of size to accommodate the quantity of names likely to be given a number; the latter is a card index, with alphabetical guides, large enough to receive a card for each name entered in the register. Perforated cards with a locked rod should be used. When a number is allotted to any name, a card is made out bearing that number and giving the full name and address of the person or firm to whom it has been allotted, which has previously been entered in the number register. This card, which is placed in its alphabetical position in the index, should also bear any special instructions regarding shipments or invoices for such customer. To provide for orders from customers who may probably not give more than the one order, the first twenty-six numbers, one for each letter of the alphabet, are reserved for sundries. Should it be found advisable later to allot a number for the name of any customer whose previous orders have been filed under any one of these "sundries" numbers, such past orders may be renumbered, or the card issued may bear a memorandum, "Before this date see Sundries No.————."

The value of this card index may be greatly increased by careful cross-indexing—i. e., where orders from the same concern are signed by different persons by placing in it a card for each name so used, bearing, of course, the number of the firm or company for which they sign, and which is looked to for payment. After a very short time, except to issue a new number, this book and index will be hardly referred to more frequently than the directory is used to ascertain a customer's initials or address, where the alphabetical system is in use.

To operate the system properly and thoroughly, in addition to the above book and index, the following cabinets are required, as well as the necessary forms and cards:

A filing cabinet, indexed numerically from one up to whatever number a careful estimate shows is likely to be required. This cabinet receives the original authority upon which each shipping order is based, and retains it until the entire order has been filled.

A number of box files indexed in the same way, to which letters, telegrams, etcetera, are transferred from the filing cabinet on completion of the order.

A card-index cabinet large enough to contain a card for each manufacturing order issued during a year, and in addition one reserve drawer for cards representing orders in process of manufacture.

Lastly, a vertical filing cabinet large enough to contain a shipping slip for each part or complete shipment made during a year, and in other drawers the cost sheets bearing a detailed statement of the cost of each manufacturing order issued during the same period—these, of course, all with the necessary guide and index cards and folders.

The outlay involved may make the expense of the plan seem great, but it must be remembered that these cabinets represent a first expense only, not an annual one. Cardboard transfer cases of the same size as the various drawers, are obtainable at a nominal cost, and each year's records are transferred to such transfer cases, the cabinets being used for the current year's work only.

The filing cabinet for the letters, etc., upon which shipping orders are based is kept in most convenient reach of the order clerk and also of the invoice clerk. To obtain the best results, a shipping order must not be issued under any circumstances without a written authority for such order being filed in this cabinet. In cases where mail matter may contain nothing requiring the attention of any but the order department, it is handed at once to the order clerk after being initialed by the proper authority. If, however, it requires the attention of any other official or department, an extract of the part containing an order is made by the stenographer, and a shipping-order number obtained from the order desk and noted on both the letter and the extract. Letters and post cards advising the return of goods are treated in the same way. For orders received from travelers, either of two plans may be adopted:—the traveler may send in his orders on a regular shipping-order form, in duplicate, and the copy may be filed in the cabinet; or the order may be received by the house on an ordinary traveler's order form or sheet, which after being re-written on a regular shipping order is filed in the cabinet. The latter plan, while giving some additional work in the office, leaves the traveler more freedom to write full particulars regarding his orders than is permitted if he has to make them out on a set form. Orders given in person or received over the telephone should be written out on a memorandum form before the shipping order is made out, and where possible the purchaser should sign the memorandum. In any event, it should contain full particulars as to by whom it was given and received, and any promised or understood date of shipment.

On receipt of orders, whether telegraphic, mail, or memorandum, the order clerk first marks prominently on each the file number of the person or firm the order is for. These numbers he can obtain by re-

ferring to the card index above spoken of, though he will very soon do most, if not all, from memory. (Any one who doubts this statement should ask the time clerk of any large factory if he finds difficulty remembering the numbers representing the names of employees). As soon as the file number is marked, a shipping order is made out and entered in the shipping-order register, being given the first blank number, which preceded by the letter "S," (shipping), is also marked on the letter, telegram, or memorandum, as the case may be. Such orders as may require it are then acknowledged by a printed post card, which also requests that any inquiry regarding the goods ordered should refer to the following numbers F———— S————. In these spaces is filled in the file number representing the customer's name, and also the shipping number given that particular order. The letters and memorandums are then filed in the order clerk's cabinet under the index sheet bearing their respective numbers. It will be seen that should a customer make inquiry regarding any order, this inquiry will bear on its face information as to the exact location of the original of the order referred to.

Each day the shipping clerk returns to the order clerk the shipping orders on which he has made a part or complete shipment. These shipments are priced by the order clerk, who issues a new shipping order bearing the same number and date for such items as have not been sent forward, prefixing "B. S." (back shipping) to the order number. Such items as have been shipped are then billed to the customer in the usual way, each entry being numbered consecutively. This number is noted both on the invoice and on the letter or other written instructions upon the authority of which the shipping order was first issued, part shipments being so marked. Letters, etc., representing orders upon which complete or final shipment has yet to be made are returned to the cabinet, while those representing completed orders are filed away in box files indexed on similar lines.

The shipping orders on which any shipment has been made have now become shipping slips. The invoice number they bear is noted in the shipping-order register, which is ruled in such way that a certain column is reserved for the entry number of final or complete shipments, those of part shipments being entered in other space. By this means a periodical examination of the shipping-order register will show at a glance what orders are in possession of the shipping department upon which no shipment or part shipment only has been made, and the date such orders were received. Without leaving the office the management can see how shipments are being got out.

During the current month these shipping slips are arranged according to invoice number. At its close a statement of their totals is taken off, showing cost and selling price of each shipment distributed among the various departments. The aggregate of the selling value will, of course, equal the total of the day book. When this is done the shipping slips are filed away in a vertical filing cabinet, arranged numerically by file number, and those for each customer according to invoice number.

A manila folder of which the inner sheet projects about half an inch above the outer is used for the charge-slips against each customer. On this space is written the customer's name and file number. As slips are inserted in these folders from month to month, it will be found that some customers may require a new folder each month, while for others one folder will take the full year's charges. Where two or more folders are required during the year for the same customers each should be marked with the months in which were made the entries for the slips therein.

In the question of manufacturing orders, more perhaps than in any other branch of office work, is this the day of cards and loose sheets instead of books. By keeping records of such orders on sheets and making out an index card for each order, a most complete system of indexing and filing may be secured with the use of the numerical system.

The foundation of the system is the entering of the number of each manufacturing order issued in the shipping-order register, opposite the shipping number of the order calling for the goods, and in each cost sheet and card for such manufacturing orders, bearing, besides the customer's name, the file number representing such name and also the manufacturing order number. Until the order is completed the cost sheets are kept arranged by the number of the manufacturing order—this for convenience in entering charges against them. The cards are filed in a card-index cabinet, arranged according to the number representing the name of the customer. The file number being known, reference to this index will show all orders in process of manufacture for any customer. Part deliveries from shops to stock room being noted on the cards, it will be at once seen what balance remains for the factory to supply. As these cards bear the number of the manufacturing order which they represent, reference to the corresponding cost sheet will show at once the progress or cost of such order to date.

Articles delivered from shops to shipping or stock room are ac-

companied by a card bearing the file and manufacturing-order number, the date, and the quantity and name of article. These cards, after being initialed by the stock-keeper, go to the office where the quantity is noted on the card representing the order. They are then handed to the invoice clerk, who retains them until he receives a shipping slip, and makes a charge for the articles thereon. This being done, he notes the entry number on them and they are filed away. It will be seen that the only cards in his possession should be those representing articles delivered from shops to stock room for a certain customer and not shipped. Failing to receive a shipping slip for the goods within a reasonable time, inquiry is made, the cause of delay ascertained, and the error or omission to charge rectified. After completion of any order, the cost is noted on the card representing that order and they are then filed according to article or class of goods. The cost sheets are filed in a vertical filing cabinet, on exactly the same lines as the shipping slips, thus being self indexing.

At the end of any given period the cost sheets, showing the details of all orders for each customer, are together, and the card records of the same will be found classified according to goods.

If this system in all its details is carefully and completely carried out, the management will have constantly at hand full information as to all orders, from the time they are received at the order desk until complete shipment has been made and billed to the customer. The point aimed at is to arrange all cards and papers as far as possible so that, the customer's file number being known, they will be self-indexing, and in addition to this, to have each card or paper indicate, in addition to the information contained thereon, where to look for more details, or for further disposition of the matter. Thus a reference to a certain number in the shipping-order register will show what shipments have been made, and the number of the day-book entry for such shipments. It will also show the number of the manufacturing order (if any), on which the goods are being, or have been, made in the shops. Reference to the card for the manufacturing order will show what (if any) part-deliveries from shop have been made, and the receipt for such deliveries signed by stock keeper will be found with the card representing the order, and will show the number of the day-book entry charging the goods to the customer. If further information is required, the card gives the number of the cost sheet on which full particulars of the cost and work to date will be found.

As regards completed orders, the shipping slips give particulars

as to the cost and selling price of each shipment. If desired, a statement may be made out each month and a similar one at the close of the year, showing the profit on sales of each department, or on sales to each State or town, or even customer, the aggregate agreeing, of course, with the total profit on sales as shown by the sales accounts.

All shipping slips for the same customer during a year being together, such slips when transferred at the close of the year to a transfer case, become practically a copy of the day book with all charges against a given customer in rotation. In looking up an entry for a given article known to have been charged a certain customer, this will be of great value. Advantage will also be found in having all orders received from customers filed separately from other correspondence. Completed manufacturing orders may be promptly referred to, whether asked for by number of order, name of article, or name of customer. The cards showing cost of the manufacture of the same article at different times will be found all together, thus practically forcing comparison.

I have treated here only the question of manufacturing for customers' orders. The indexing, handling, and recording of orders for the manufacture of goods for stock may also be most advantageously done with cards and loose sheets.

The plan here described is largely the result of study along lines suggested by one who ranks high as an authority on shop practice and management. In a personal letter he said "in these days of the card index, one should have a full comprehension of the possibilities of that index in all parts of the administration department of a machine shop.

# THE BRIQUETTING OF FUELS AND FINE MINERAL ORES.

*By Wm. Gilbert Irwin.*

The utilisation of waste products in various lines of work has furnished many fruitful fields for the work of the engineer. In industrial health, as in bodily health, however, prevention is better than cure, and everything which tends to prevent the occurrence of waste may be considered as a direct contribution to national wealth.

Mr. Irwin shows how the introduction of modern briquetting machinery prevents waste, not only in connection with fuel, but also in various lines of metallurgical industry, to the manifest advantage of both product and methods.—THE EDITORS.

IT has been within a comparatively recent period only that American manufacturers have been giving any definite attention to those numerous lesser economies which for a long time have been the subject of careful study on the part of the learned scientists of Europe, and have long been exploited by many European manufacturers; but during the last few years remarkable progress along these lines has been made in the United States. The extravagant abundance of all kinds of raw materials has been largely responsible for the neglect which prevailed until within the last half-dozen years or so, and while there is as yet no diminution of the raw materials in sight, American manufacturers have come to realize that the greatest economies really lie in getting the most workable materials from the smallest body of raw material—or, in other words, in producing a maximum of output with a minimum of effort. These ideas have long prevailed in the countries of continental Europe, having been impelled from the conditions existing there. The ore, fuel, and other raw-material supply of those countries has long been limited, hence the necessity for the strictest economy along all lines.

For a long time the great universities of continental Europe have displayed a keen interest in matters of social and industrial economy, and in consequence the manufacturers of those countries have greatly benefited from such studies and researches. However, great as has been the progress of some of the countries of Europe along strictly scientific lines, made possible through the great institutions of learning built up during many centuries, the more inventive mind of the American scientist has readily absorbed the result of all this progress, and within a few years has made many new departures based upon the researches and ideas evolved in the Old World. A striking in-

stance of this is to be seen in the briquetting industry. For many years the briquetting of mineral fuels has been carried on extensively in Europe, and the first attempts at briquetting made in America were confined to similar lines. However, it was not long until the idea of applying the same process to other minerals was evolved, and as a result the briquetting of fine mineral ores has, through the experiments of the past six or eight years, come to be an important feature of metallurgical practice.

While the briquetting industry as carried on in continental Europe and in England is still almost wholly applied to the briquetting of mineral fuels, three distinct fields for this important economic industry have already been exploited in the United States, i. e., the briquetting of coal and coal dusts, lignite, and other forms of mineral fuel, along which lines the industry was first exploited in Europe; the briquetting of fine ores and flue dusts; and the briquetting of precious mineral ores. The application of briquetting to other than mineral fuels, as has already been intimated, is strictly an American idea, evolved through necessities arising from the operation of modern precious-mineral smelters, and to meet certain conditions arising from the advanced departures in iron-furnace operations.

Before entering upon a discussion of the scientific application of the briquetting industry to these new requirements, it will be well to trace the progress of the idea as originally applied to the fuel industry, along which lines the briquetting industry is destined to undergo a wonderful development in America at no distant day. The idea of compressed fuels can be traced back to the year 1594, when Sir Hugh Pratt wrote a pamphlet upon the subject; but it was not until the year 1842 (when the mechanical manufacture of fuel briquettes on a commercial scale was begun at Berard, near St. Etienne, France, from which country the industry was introduced into other countries of the Continent and into England) that briquetting in the modern sense of the word, received its first exploitation; and from that time down to the present day the progress of the industry has largely been marked by the evolution of briquetting machinery. The early ideas involved the single-compression press, such as the Mazeline, Stevens, Crozot, Exeter, Revollier, Dupuy, Matin and similar presses. A tangential machine for the manufacture of ovoid balls of fuel for domestic and other use was also evolved and had a wide use in continental Europe. Then came the double-compressing machines in which the briquette is formed against the back of another. Of this type may be mentioned the Evrard and Bourriez presses. Another type of press evolved in

Europe was the roller press acting tangentially to which type belong the Loiseau, Gilly, Maison de Beer, Zimmerman, and Fouquemberg machines.

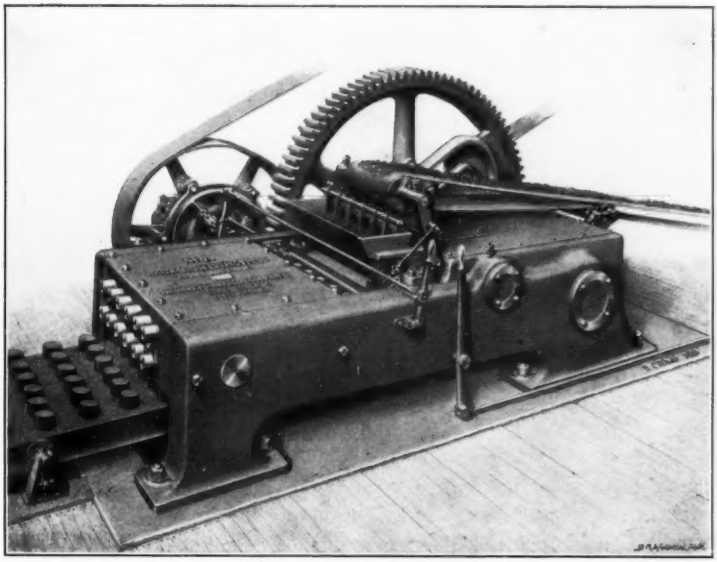
After the success of the idea had been demonstrated through the operations at Berard, numerous other plants were installed on the Continent and in England. Among these may be mentioned the plant of the Paris, Lyons and Mediterranean Railway at La Chazotte employing the melted pitch process, which process was also used in the early attempts at fuel briquetting in the United States. The Parrache Gas Works at Lyons also operates a briquetting plant and uses the Dupuy horizontal press. The Jacoby-Louvre press is largely used in the Halle district of Prussia, while at Castelnuovo in Italy a modern briquetting plant has just been installed for the manufacture of fuel briquettes from lignite, which feature of the industry is now an important one in various European countries. The Paris Gas Company for some years manufactured briquettes from coke refuse, and this is also being done at other points in Europe. A pioneer plant in the dry-pitch method of briquetting was that installed at Newport in Monmouthshire, England. In this process, as in the wet-pitch process, the pitch is broken in a pug mill and then added to the fine coal dust, the mixture being heated in order to render it pasty and cause a cohesion. In experiments conducted abroad various binding materials such as pitch, tar, farina, starch, dextrine, clay, sawdust, plaster of Paris, lime, chalk, magnesia, sulphur, paper-pulp, nitrate of potash and silicate of soda have been used. In tracing the development of the fuel briquetting industry in America further mention of these will be made. The cost of fuel briquettes per ton in England averages 9s. 7.45d. ($2.32) and in France 13s. 0.96d. ($3.14) while the cost in other European countries varies but little from these figures.

While no definite effort looking to the systematic utilization of waste anthracite and bituminous coal was made in the United States until 1868, patents bearing upon the subject were allowed by the United States patent office as early as 1837, and since that time more than a hundred bearing directly and indirectly upon briquetting have been issued. For a long time the foreign systems were closely followed by the American exponents of briquetting for the utilization of fuel waste, but more recently efforts along these lines have taken a new departure and briquetting machinery of a strictly American type, evolved with special reference to the requirements of the waste fuels of the country, is to be employed in turning the waste mineral fuel into the uses of modern industry.

The first attempt to install a mechanical briquetting plant in America was made at Port Richmond, Philadelphia, in June, 1868, when a plant of the Loiseau system, the invention of E. F. Loiseau, a Frenchman, was begun for the briquetting of anthracite culm; but it was not until some years later that this plant was finally completed and put into operation. The manufacture of compressed fuel was begun at Rondout on the Hudson by the Delaware and Hudson Canal Company in 1876, 92 per cent. of anthracite culm and 8 per cent. of pitch being used. This plant was sold to the Anthracite Fuel Company the same year and its operation was discontinued in 1880. The Port Richmond plant was also abandoned after having been operated for a few years. Before this time an attempt to manufacture briquettes from anthracite culm at Mauch Chunk proved a failure. In 1890 the Anthracite Compressed Fuel Company was formed, and a briquetting plant was installed by the company at Mahanoy City in Schuykill County, Pennsylvania. The plant was operated for about two years and was finally abandoned in 1895. Similar plants were also installed at Gayton (Virginia), Milwaukee (Wisconsin), Huntingdon (Arkansas), and at Chicago. In all of these plants the manufacture of small briquettes, known as "eggettes," was conducted in accordance with the ideas evolved in Europe where this type of machinery was first used.

While these early attempts at briquetting resulted in no permanent establishment of the industry, some valuable experience was gained. The operations in the anthracite-coal fields of Pennsylvania demonstrated that briquettes can be manufactured from anthracite, using coal-tar pitch as a binder, at a cost of $1.80 per ton. In these early operations bituminous slack coal and lignite were also briquetted with some success. It was also shown that pitch and vegetable compounds are best suited for binding for fuel briquettes. Pitch adds a great amount of smoke, and it is quite probable that in future operations the vegetable bindings, such as farina, dextine, and starch, will come into wide use for purposes of binding. Lime, which is largely used in briquetting fine minerals, has been found to add considerably to the ash when used in fuel briquettes, hence its use in this line of briquetting will necessarily have to be abandoned.

In preparing coal for briquetting it has been found best to put it through a series of washing or "jigging" processes in order to reduce the percentage of ash and sulphur. Special apparatus has been evolved to measure the cohesion, and the calorific power of the fine coal thus prepared is slightly, if at all, lower than that of unbroken coal. To



WHITE BRIQUETTING PRESS.

Capacity 100 tons every 10 hours.

sum up the knowledge of fuel briquetting obtained through these early attempts at briquetting in the United States, it may be said that it was found that this artificial-fuel product must be homogeneous and hard so as not to break in transportation, its combustion must be as near smokeless as possible, it must be of a convenient size and shape, must not be hygroscopic, must not contain more than 5 per cent. of moisture, must leave a minimum of ash, must be easy to kindle, and must burn freely.

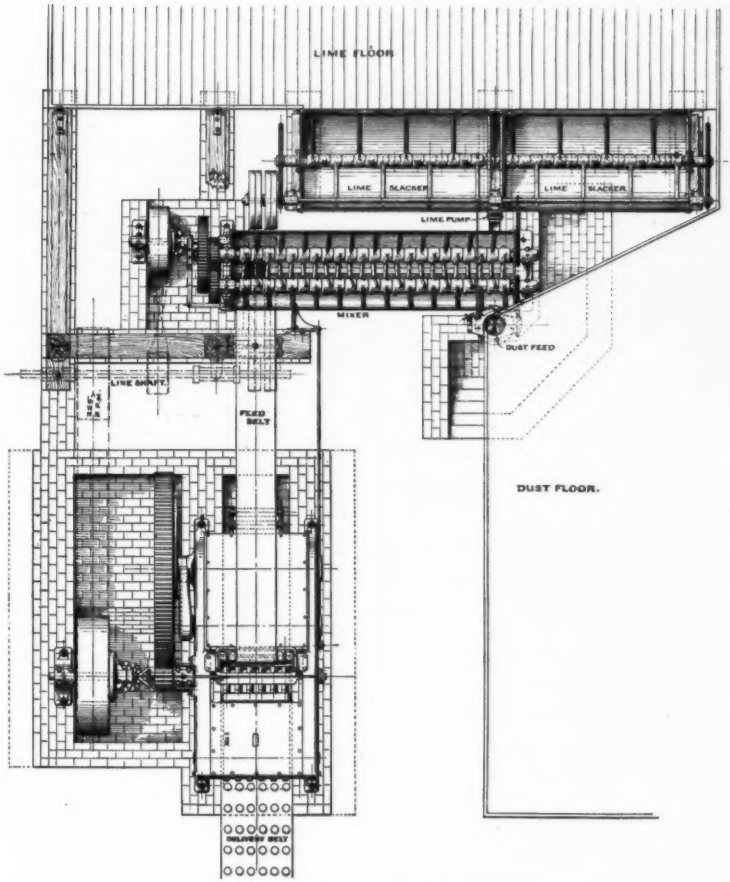
With the knowledge thus gained, supplemented by the results of recent work along the same lines to draw from, the capitalists who are in the future to turn the millions of tons of slack and worthless anthracite and bituminous waste, and the lignite and brown coals, to the uses of modern industry through the briquetting industry can now conduct the work with some degree of certainty. During the past few years the progress of the briquetting industry has largely been a record of the evolution of briquetting machinery; hence the necessity of here devoting some space to the progress of briquetting presses.

Some six or seven years ago a smelting company in the western

States purchased a Boyd brick press and began a series of experiments in briquetting flue dust, fine ores, concentrates, and other non-elastic materials. While the press was perfectly adapted to brick making, it proved a failure when applied to a use for which it was never intended. However, from the attempt was evolved the idea of constructing a press for the briquetting of fine minerals and for some time Mr. B. C. White, one of the early advocates of briquetting in America, devoted his efforts to adapting a brick press to the purposes of mineral briquetting. The result was an elimination of the grinding pans, mixers, elevators, spouts, and press used for brick making, and the invention of a combined mixing and briquetting press, known as the White mineral press, which was perfected in 1896. Although this machine supplied a long felt want in the way of briquetting presses, it underwent decided improvements soon after it was placed on the market. As the result of further study along this line combined with a thorough examination of the briquetting systems of England and continental Europe, the White briquetting press of 1899 was perfected and put into quite extensive use, its operation proving entirely successful. The complication of such machinery was further eliminated in the White briquetting press of 1901, which machine was brought to a high state of perfection through improvements made since.

The White briquetting press is made in three sizes, Nos. 1, 2 and 3. The No. 1 press has a capacity of 100 tons per ten hours in briquetting precious metal ores or iron flue dusts, while Nos. 2 and 3 are adapted to briquetting on a less extensive scale.

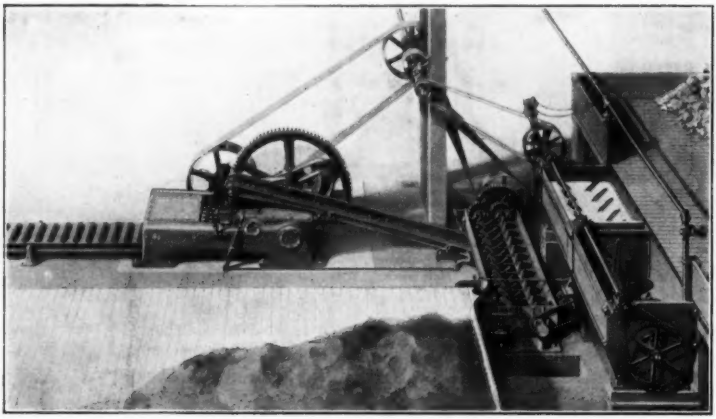
This machine, through a system of interchangeable pockets and plungers, is applicable to various requirements of mineral and fuel briquetting and today the system is in use by many mining companies in various parts of the United States and other countries. A model experimental plant has lately been put into operation in Pittsburg, a description of which will adequately convey the mechanical operations involved. In mineral briquetting a lime binder is used, while pitch or vegetable binding material is used in fuel briquetting. The slackers, two in number, which prepare the binding material, communicate by large openings at the bottom of the hollow middle casting and operate alternately, so that while the binding material is being slacked in one the pump will be drawing the prepared binding material from the other, a cut-off valve which opens or closes either of the openings being operated from above. The openings are screened to prevent lumps from getting into the pump. The slackers are driven




GENERAL ARRANGEMENT OF WHITE BRIQUETTING PLANT.

Showing lime slacker and mixer, and delivery of material to and from press.

independently by tight-and-loose pulleys, belt shifters which are operated from the floor above the slackers being supplied. The binding pump is driven by a chain from one of the mixer shafts, its stroke being regulated by a rod and hand wheel mounted on the dust feed, by which the amount of binding may be accurately adjusted. The materials to be briquetted are conducted into an automatic dust feed through an opening in the dust floor through an automatic arrange-



WHITE BRIQUETTING PRESS AND OUTFIT.

ment, the feed being driven by a chain from one of the mixer shafts. The materials to be briquetted are fed automatically into the press, which is provided with a friction clutch pulley driven from a pulley on the line shaft, the clutch being automatically operated. The man in charge of the press has also control of the whole machinery of the plant. At this experimental plant all kinds of minerals and fuels are being briquetted with a view to the further development of machinery along this line, and in order to adapt the machinery to the varied requirements of the industry.

Another exponent of the coal briquetting industry in the United States manufactures the Belgium Mineral Press. This machine in connection with the Gardner Corning fuel briquetting patents is used at the plant of the Briquette Coal Co., of Chicago. Through the use of a patent binding material, briquettes manufactured by the Corning process are almost smokeless and they possess superior qualities of toughness and density, retaining their form long after they have become incandescent and reduced to a white ash.

In this system the coal is reduced to a pulp by being passed through powerful crushers before the binding material has been added. The mass is then carried to a furnace where a temperature of from 180° to 200° F. is maintained, and is thus heated sufficiently to make the binding material adhere firmly and to produce the desired results without in any way changing the chemical composition of the coal dust. It is then conducted by an automatic elevator to the floor above,

where it is mixed with the binding material while it is still warm. It is now ready for the press which subjects it to a pressure of about five tons to the square inch and when the briquettes drop out of the machine onto the conveying belt they are firm and hard. Unlike mineral briquettes, fuel briquettes require no cooling process in order to solidify them.

The Belgium mineral press has also been adapted to fuel briquetting, it being an interchangeable press equally suitable for the briquetting of mineral or fuel products. The plans of this company for a coal briquetting plant equipped with the Belgium mineral press include one dry pan to crush and screen the coal as it comes from the dryer. The fine coal dust is then elevated into a hopper, from which it is drawn into a measure. Opposite this measure is one which measures the binding material, and the whole material to be briquetted is then turned out into a mixer which thoroughly incorporates the binding material with the coal. From the mixer it passes into the press and from there the briquettes, or "eggettes," are conveyed to the elevator and storage bins, ready for delivery to the markets.

Considering the fact that England and the Continent now produce nearly 20,000,000 tons of fuel briquettes annually, largely from waste slack coal which otherwise would be useless, some idea of the importance of the industry there will be gleaned. Already fuel briquettes are being exported from Europe to several South American countries, where they sell as high as $8.00 to $9.00 per ton as against half that sum paid for American coal. The field for the fuel briquetting industry is, indeed, a wide one, and the near future is certain to see the millions of tons of waste coal refuse which has collected about the mines of the anthracite and bituminous coal fields turned to a commercial value through this new industry. Among the advantages of the fuel briquette is its freedom from dust when handled. For marine purposes, briquettes possess the advantage of storing a greater amount of heating power in a much smaller space than is the case with ordinary coal. Tests made of this compressed fuel on railroads in the Western States have been very satisfactory, and the same flattering results have been obtained through long tests conducted in mills and factories.

A fuel-briquetting plant for the manufacture of compressed fuel from coal dust and petroleum has lately been installed at Stockton, California, and numerous other plants of various types are now being projected in various parts of the United States, indicating that

BRIQUETTING PLANT OF THE HALL MINES SMELTER, NELSON, B. C.

this important economic fuel industry is about to enter upon a wide development.

Proceeding to those departures made by American genius in the briquetting industry, as noted at the beginning of this article, it appears that of these the briquetting of fine precious-mineral ores and dusts had its first exploitation, and, as already mentioned, an early attempt at briquetting such ores and dusts was made with a brick press, with but little success. Since that time improved mineral-briquetting presses have been perfected, being the same as already described in connection with fuel briquetting, fitted with pockets and plungers to suit the requirements of this modification of the process. The object sought in adapting briquetting to the smelting of fine ores is to obviate the great loss heretofore ensuing from the escape of flue dusts, concentrates, and granulated mineral fines during the smelting process, and to put the fine mineral ores, tailings, and similar fine materials into such a form as will admit of their being treated in the smelter without the great loss which has heretofore resulted. For a long time before briquetting was taken up as the logical solution of this problem by smelter managers, immense sums had been expended in experiments along many lines; but today many large and small smelting concerns in the western States are either operating or installing briquetting plants for the treatment of fine dusts, and in many instances materials which for years have been running down the cañons or into settling basins, are being carried back to the smelters and, after being solidified in the form of mineral briquettes, are being

re-smelted with considerable profit. Through the treatment of these mineral fines and of flue dusts and slimes from the concentrators, it has been found possible to increase the smelter output from 10 to 20 per cent., old ore dumps, flue dust, etc., containing as low as 3 to 6 per cent. of mineral value being treated by the briquetting process with much profit. In addition to these advantages, the briquetting industry as applied to fine minerals eliminates numerous disadvantages arising from the use in the smelter of concentrates and fine ores in their natural state.

Aside from the establishment of many briquetting plants at the smelters, many mine owners in the western States have erected briquetting plants at their mines. The blast used in the smelter, while

BRIQUETTING PLANT, COMPANIA DE PINOLES SMELTER, MAPINI, DURANGO, MEXICO.

not nearly as strong as that used in a blast furnace for the reduction of iron ores, is still strong enough to force out a large quantity of fine ore in the form of flue dust. In order to catch this flue dust, the gases and fumes from the top of the smelter are forced through long underground tunnels before they are finally emitted from the stack, and in this tunnel a considerable percentage of the dust is deposited. At intervals the tunnel is cleaned, and this deposit after being treated by the briquetting process is again sent to the smelter.

One of the serious difficulties experienced with earlier types of briquetting machines was that blocks of ore after coming from the press could not stand the necessary rough handling between the press and the smelter. However, the improved mineral press, heretofore described, effectually overcomes this difficulty. At Jerome, Arizona, where the United Verde Copper Company has in operation a briquet-

BRIQUETTING PLANT, KENDRICK AND GELDER SMELTER, SILVERTOWN, COLORADO.

ting plant equipped with this type of press, the briquettes are dropped from the end of the delivery belt into a car seven feet below without any crumbling, no intermediate drying process being necessary in this instance. This is only one of the many instances of the successful operation of briquetting machinery as applied to the fine ores. Similar plants are now in operation at the Globe smelter plant of the American Smelting and Refining Company at Denver, Colorado, and at other plants of that company, by the Bingham Consolidated Mining Company of Salt Lake City, the Anaconda Copper Mining Company of Anaconda, Montana, the Hall Mining and Smelting Company of Nelson, British Columbia, the Compania Minera de Penoles, of Mapini, Mexico, and by other mining and smelting concerns in United States, Canada, and Mexico, while American briquetting machinery is now also in operation in Australia and other distant countries. As already stated, the binding material now in general use in briquetting fine mineral is lime. In some of the fine ores of Western America it has been found that no binding material need be added, as they contain just the silicious materials necessary to produce a perfect briquette.

The first attempts at briquetting fine furnace ores and flue dusts date back to the year 1896, when a white mineral press was installed at the plant of the Carrie Furnace Company at Rankin, Pennsylvania, near Pittsburg, and about the same time the Illinois Steel Company began experiments along the same line with a Boyd brick press, which this company is still using for the purpose, having since that time installed an improved White mineral press. In the earliest attempts at briquetting fine iron ores and flue dusts sufficient pressure was not

exerted to form solid blocks and no attempt was made to dry the briquettes, they being taken in their green state and dumped into the furnace. Later improvements made in briquetting presses together with the perfection and introduction of automatic drying apparatus, a necessary adjunct in modern iron-ore briquetting, this departure of the briquetting industry has been brought to a high degree of perfection, and is already considered a necessary adjunct of the iron manufacturing industry. Many of the largest iron and steel manufacturing concerns have already adopted the new idea, while numerous other briquetting plants for the utilization of fine iron ores and flue dusts are either being installed, or preparations for their adoption are being made, and in this manner will be turned to the uses of modern industry, those materials which heretofore were not only a decided loss, but which produced many disastrous explosions. Furnaces running with briquettes on the charge run much more regularly and show a marked improvement. Briquettes made of flue dust are delivered in the bins ready to be drawn into the charging bogies, or larry cars, the cost being considerable less than $1.00 per ton, allowing for interest, depreciation of plant, labor, lime, oil, waste, fuel, and drying; and they really take the place of ore costing three times their value per ton, the furnace output when operated with briquettes being equal to that obtained with high-grade ore.

The adaptation of the briquetting industry to iron ores involved the same principles and processes employed in the briquetting of fine minerals. For some years the supply of Mesaba ore in lumps of sufficient size for use in the large blast furnaces has been decreasing, and as the Mesaba ores are very rich in iron and can be delivered very cheaply in Pittsburg and at other centers, they have long had a wide use in the iron industry. They also contain a minimum of phosphorus and sulphur, hence they are lacking only in their physical condition—i. e., they cannot be supplied in sizes large enough to suit the demands of the modern blast furnace. Within the last twenty years the capacity of the blast furnace has been vastly increased. The 150-ton blast furnace was supplanted by that of 300 to 350-tons daily capacity, and this type in turn gave way to the modern 600-ton blast furnace, each of these types being marvels of mechanical and scientific success in their day. Just now, in view of the lack of Mesaba ores of a suitable size for the large furnaces, manufacturers have about come to the conclusion that so far as concerns the increase of the blast furnace, the limit has been reached. Just as long as the supply of lump ore continues the big furnaces will be a success, their operation being

conducted on a much more economical scale than was possible with the smaller furnaces of former days. However, even in the large blast furnaces there is a decided loss in form of fine ores and flue dusts, this loss reaching from 40 to 50 tons daily. Giving Mesaba ore a value of $3.50 per ton delivered at the furnaces of the Pittsburg district, it will be seen that the loss in the form of fine ores and flue dusts for a 600 ton furnace amounts to $125 per day. The accumulation of these fine ores and dusts in the furnaces is responsible for many disastrous explosions, jeopardizing life and property. Furnace explosions due to this source are of quite frequent occurrence, and many cases might be cited. The weight and exceeding fineness of Mesaba ores when used in great quantities are certain to cause "clogging," and the ores becoming packed together leaves no escape for the gases, hence the formation of gas pockets resulting in explosions. When these gas pockets are formed near the top of the furnace, enough relief is obtained by blowing out of the top of the furnace; but when the difficulty occurs deeper in the furnace great destruction results.

In view of this state of affairs, the present blast furnace conditions present a most serious question, and one which is now receiving the attention of experts every where. The question involved means either the abandonment of the monster modern blast furnaces or the adoption of briquetting as a relief to present conditions. By this method the fine ores are prepared in solid form before being charged into the furnace, and the fine flue dusts, through a process similar to that involved in treating precious-mineral flue dusts, are to be recovered and turned into use in form of briquettes.

In summing up the progress already made by the briquetting industry, it will readily be seen that this new economic development is destined to inaugurate a new state of affairs in the matter of fuel economy. Great advancement in the reduction of precious-mineral ores has already been made certain through the new industry, while it is early destined to come into wide use in blast-furnace practice. The past has been a period of nurture and experiment rather than one of exploitation for these new ideas, and the progress already made has pretty generally demonstrated to the satisfaction of the manufacturing world their real worth.

# EDITORIAL COMMENT

"If people think right, they will vote right," is an axiom among successful politicians. In like manner, industrial managers, and especially the organizers and directors of great industrial enterprises, are beginning to see plainly that to think right on economic subjects is the very basis of all lasting and great success.

It is for this reason that we attach the highest importance to the masterly paper with which Mr. George H. Hull leads this number of THE ENGINEERING MAGAZINE. A few years ago, such a discussion would have been appropriate only in the pages of a journal devoted to political science,—would have been the concern of a very narrow circle of students and specialists who devoted themselves to the theories of political economy. But engineers and industrial managers are learning very rapidly in these days that if we are not directly concerned with the abstract theories of political economy, we are very vitally concerned with the concrete and practical problems of industrial economy. For betwixt trade unions, strikes, trusts, combinations, "community of interest," and so on, active men of business are finding it very necessary to be well-informed upon the underlying principles which operate so actively to make good times or bad times in this ordinary work-a-day world. Happily we seem now to have entered upon a season when prudent men can make plans for the future with the assurance of stable conditions for some years to come—provided something doesn't happen! And the thing which now seems most certain to happen, is that unthinking people, and especially uninformed newspaper writers, will soon begin to conjure up the bug-a-boo of over-production.

* * *

In Germany, for example, we have heard much of late concerning bank failures, over-capitalization of syndicates, over-speculation, over-production, and especially a widespread depression in all branches of the electrical industries. The latter fact is worthy of special note in this connection, for it is in Germany that the electrical industries have of late years seen their greatest development. Naturally enough, therefore, upon the heels of this financial and electrical depression in Germany, we have witnessed a panicky disturbance in the copper markets. The market price of copper itself suddenly dropped one-third or more, while the market value of shares in copper companies suffered an even heavier decline. The usual and plausible explanation of the copper disturbance was, of course, "over-production." But the thoughtful man who will read Mr. Hull's scholarly paper must see plainly that the promoters of copper company shares simply attempted to corner the copper market, and, as usual, advanced prices to a point which made the extensive use of copper impracticable. Now that copper has declined sharply, and under natural competition promises to remain at a normal price, we can confidently anticipate renewed activity in the electrical industries, with steadily increasing consumption of copper, and hence, conditions of stability and security in both the copper and electri-

cal industries—so long as normal prices are maintained.

As Mr. Hull points out, precisely the same thing happened in the iron markets two years ago. Owing to a needless scarcity and a senseless boom, the market price of pig iron was more than doubled—was actually carried to a point which forced consumers to stop buying, and, of course, involved thousands of manufacturers in heavy losses. The inevitable result was a heavy falling off in the demand for iron, the abandonment of plans for new enterprises and betterments requiring iron and steel, and with these conditions, a steadily falling market, and the customary senseless cry of "over-production."

* * *

Now, it is high time that this brainless talk of over production were ended, and we feel that Mr. Hull has placed the entire engineering and industrial world under obligation for his masterly exposure of so obvious a fallacy. The political economists long ago demonstrated, in theory, that over-production of useful products is impossible; but to Mr. Hull belongs the distinction and honor of bringing theory home to us in sober, everyday facts. For every word that he has written is simply current industrial history, and it is so ably and so eloquently written that every man who reads and thinks must see the far-reaching importance of his teaching.

Fortunately, also, the managers of the greatest of recent combinations, the United States Steel Corporation, show plainly that they have at least learned part of the wise lesson which Mr. Hull teaches. In their preliminary annual report, lately issued to stockholders, they say this:

"The demand for the products of the several companies has been so great that prices could easily have been advanced. Indeed, higher prices have been voluntarily offered by consumers who were anxious for immediate execution of orders, but the companies have firmly maintained the position of not advancing prices, believing that the existing prices were sufficient to yield a fair return on capital and maintain the properties in satisfactory physical condition, and that the many collateral advantages to be gained in the long run by refusing to advance prices would be of substantial and lasting value, not only to the companies, but also to the general business interests of the country. The strong position thus taken by the companies for stability in prices, both of raw material and finished products, has had a reassuring effect on the trade, and has contributed greatly toward restoring confidence in the general business situation and creating the present large demand for steel products, by dispelling any doubt as to prices in the future."

Well said, gentlemen! Stick to that program; keep your furnaces, mills and factories running steadily; keep your workmen continuously employed at good wages; keep your customers supplied with all your products at prices that baffle competition—do these things, gentlemen, and all the world will warmly approve of your system, your organization, and your methods of doing business. But, meanwhile, be assured that if you do not do just these things, and do them willingly, as you have so well begun, your competitors at home and abroad will certainly force you to do them. For competition is still the order of the day in all branches of iron and steel manufacture, and it is the part of both wisdom and prudence to take careful note of the significant fact that England, Germany and Belgium—instead of being "out of it"—are knocking hard at the rickety tariff fence which hedges about the "infant industries" of America.

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THE progress toward electrification of the London underground railway drags its slow length along, but sometimes it appears to be headed in the wrong direction. The question of system being at last settled—and we believe well and wisely settled—by arbitration, now new troubles must needs be raised by the rival projects of the component companies, the Metropolitan and the District, for establishing power stations and selling current to one another. It recalls the Apostolic figure

of the quarrel among the members, while meantime the whole body suffers. But Mr. Yerkes is again on the ground in person, and in this matter, as in the case of the original difficulties, may find a quick way of sundering the Gordian knot.

These Siamese twins of the railway family really should live more peaceably together, for live together they must. And, as if to frighten them into good behaviour, "the Tube" is seeking powers to build from Hammersmith to the city, under Piccadilly, the Strand, and Fleet Steet, with connecting loops to the Central London line at both ends. This would make a new circle within the circle, underlying the greatest avenues of surface travel in London. Well might one point the Metropolitan-District to this spectre and say, "Now, will you be good?"

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THE discussion of Mr. Orcutt's paper before the Institution of Mechanical Engineers, noticed at length elsewhere in this number, must certainly have impressed most of those present with the fact that the delimitation between so-called American practice and so-called British practice—that is, between smart, up-to-date working methods, ready to seize on every improvement in machinery and every device for labor-saving, and conservative management holding closely to tradition and precedent—that this line of demarcation has become at least a highly irregular one. The new practice has interpenetrated and overspread the old at an infinity of points. It is not merely transplanted, but ingrafted, and is growing up in adaptation to its environment. Any American who thinks Britain is still asleep would himself be suddenly awakened to find British works managers, in so large proportion, keenly alive to the most advanced work being done in Germany or the United States. There is, indeed, some indication that America may suffer ere long as Britain has suffered—from over-confidence in her own superiority and under-estimate of the ability of her rivals to catch up.

* * *

APROPOS of the fallacy of the theory of over-production, noticed elsewhere in these columns, it is interesting to recall the stirring words of the sage of Chelsea, uttered more than fifty years ago, when England was in the throes of corn-law repeal, and at the beginning of free trade.

"What will reflective readers say of a governing class, such as ours, addressing its workers with an indictment of *over production!* Over production; runs it not so? Ye miscellaneous, ignoble manufacturing individuals, ye have produced too much! We accuse you of making above two hundred thousand shirts for the bare backs of mankind. Your trousers, too, which you have made, of fustian, of cassimere, of Scotch plaid, of jane, nankeen, and woollen broadcloth, are they not manifold? Of hats for the human head, of shoes for the human foot, of stools to sit on, spoons to eat with—nay, what say we hats or shoes? You produce gold watches, jewelries, silver forks, and epergnes, commodes, chiffoniers, stuffed sofas—Heavens! the commercial bazaar, and multudinous Howell-and-Jameses cannot contain you. You have produced, produced; he that seeks an indictment, let him look around. Millions of shirts, and empty pairs of breeches, hang there in judgment against you. We accuse you of over producing; you are criminally guilty of producing shirts, breeches, hats, shoes, and commodities in a frightful over abundance. And now there is a glut, and your operatives cannot be fed! Never, surely, against an earnest working mammonism was there brought, by

game preserving aristrocratic dilletantism, a stranger accusation, since the world began."

Too many shirts in a world of nine hundred millions of bare backs might well strike others than stern old Carlyle as something quite other than over production; something rather in the nature of defective distribution. All this has been well set forth by Mr. Hull, and this practical application in altogether scientific and engineering manner, of a feature which formed a part of the free-trade struggle in England comes with especial effect at a time when similar forces are at work in other parts of the world.

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THE remarkable manner in which the admirable presentation of the advantages of the Panama route for an isthmian canal by General Abbot in the January issue of THE ENGINEERING MAGAZINE has been received by the press of the United States and Europe, is a convincing tribute to the interest which is taken in engineering matters by the intelligent public.

The matter is not without its amusing side. The Magazine has been criticised for this publication because it is assumed to indicate a change of front; and reference has been made to the fact that in its pages the points in favour of the trans-continental railways have been advocated by Mr. Nimmo, and the advantages of the Nicaragua route have been set forth by Professor Haupt. Opposed to this is the open statement which has been made, that THE ENGINEERING MAGAZINE is the organ of the Panama company!

THE ENGINEERING MAGAZINE is the organ of no company, and of no individual. It aims to present all sides of all important questions in which the work of the engineer is involved; and there are few questions indeed to-day in which the work of the engineer is not involved. It has been consistently in favour of the Panama route at all times because that route possesses such manifest advantages as to appeal to engineers in all parts of the world; it advocates that route because it *is* an Engineering magazine. The Nicaragua route has been advocated by the great mass of the unthinking public, skilfully led by able politicians through appeals to sentiment and enthusiasm, while all the time the great majority of the engineering profession, composed of the men who are in a position to understand and appreciate the real merits of the two routes, has known and maintained that the Panama route is immeasurably the superior. Whatever the outcome may be, there can be no compromise between right and wrong, and THE ENGINEERING MAGAZINE again affirms, as it repeatedly has before, that the Panama route for the isthmian canal is right, and the Nicaragua route is wrong, and in this opinion it is sustained by an overwhelming majority of intelligent engineers throughout the world.

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WE have called attention to the value of the card index system many times in various articles which have appeared in the Magazine, but we desire especially to emphasise the very wide field which is opened for it in industrial establishments by the method proposed by Mr. Falconer in his article elsewhere in this issue upon the numerical method of filing and recording orders. Such a system is applicable to letters, papers, memoranda and data of all sorts, and there is no one who can fail to appreciate the satisfaction which the possession of such a record of information would afford. We commend this paper to all works managers and urge that they experiment with the system in their daily work.

# REVIEW OF THE BRITISH PRESS

### Modern Machine Methods.

THE readers of THE ENGINEERING MAGAZINE will doubtless remember the valuable papers written for its pages in 1899 by Mr. H. F. L. Orcutt upon machine shop design and organisation, and welcome further discussion of shop methods from the same pen. Mr. Orcutt has recently presented a paper before the Institution of Mechanical Engineers upon modern machine methods, and in view of his wide and international experience, covering the United States, Germany and Great Britain, his views will be examined with much interest.

Realizing that there is an increasing tendency to minimize hand labour and to reduce manufacturing purely to machine operations by the aid of accurate tools and fixtures, Mr. Orcutt assumes that the lines on which manufacturers will work in the future will mainly be in the direction of perfecting methods of machining. His paper, therefore, dealt with modern machine methods, comparing these with laboriously expensive hand work, or machine work performed upon tools of comparatively simple design unaided by highly developed tools, fixtures and gauges.

There is no doubt that the skilled worker has long since reached the limit of his productive capacity, while the individual, aided by the labour-saving automatic machine, has an output which is practically unlimited. By either method a high degree of accuracy is possible, but accuracy combined with cheapness is possible only under the new conditions, while interchangeability is commercially impossible except in establishments equipped with the best machines tools and gauges.

Mr. Orcutt calls attention to the fact that there are few, if any mechanical operations which may be called new, since turning, milling, planing, grinding and boring are as "old as the hills." It is only the latter-day developments in these older operations which form the subject of discussion, and these, as stated above, have in the main the object of vastly increasing the output while at the same time giving a high degree of accuracy and practical interchangeability of product.

The simplest, and yet one of the most important appliances for enabling workmen of moderate skill to produce accurate and interchangeable work is the limit gauge. Standard gauges are well known and possess many advantages, but there is no way of knowing how closely they have been used by the workman. The limit gauge, however, must go on at one end and not go on at the other, and this assures the superintendent that the dimensions of the piece must lie somewhere between the limits of the two gauges. With such gauges, comparatively unskilled labour will quickly learn to produce accurate work, and the element of judgment, so far as the workman is concerned, does not enter into the matter at all.

Passing from limit gauges to machine tools, Mr. Orcutt discusses the wide range of operation of the milling machine, as compared with its use a few years ago. Improvements in design, and increased skill in the manipulation and care of tools are the two factors mainly responsible for its success. It has largely displaced the planer and shaper, and instead of being used only when a large number of similar parts are required, it is frequently found profitable to set up a machine for a run on ten or a dozen pieces. In order to obtain economical results in milling up-to-date machines must be used, there must be a plentiful supply of good milling cutters and tools, and there must be good tool makers, who know how to keep both machines and tools in the best of condition. This last requirement is by no means limited to milling work. Indeed the essential of modern economical production, next to the use of the best modern tools, lies in the separation of the preparation and care of tools from their operation. A limited number of highly-skilled and highly

paid tool makers should be entrusted with the care of the machines and the preparation and care of the tools, and the work of the operatives limited merely to the tending of the machines. In this way the cost of the skilled labour is divided among so many machines as to form but a small element in the production cost, and the great bulk of the labour, which bears a direct relation to the product, may be performed by much cheaper men. Mr. Orcutt describes various milling tools and methods, comparing the product and results with planing.

Grinding, although one of the oldest of machine operations, has been developed as an accurate surfacing method only within the last few years. Now, however, the accurate grinding machine is no longer limited to the tool room, but has found its place in the shop as the cheapest and best machine for producing mechanically correct cylindrical surfaces where good work and interchangeability are required. The turner and the file cannot compete with the grinding machine and the limit gauge. Mr. Orcutt believes that except for heavy work, the grinder and the turret lathe will in the near future absorb 50 per cent. of the lathe work now performed by skilled turners.

The lathe will continue to be one of the most important machines in an engineering establishment, but its work will be materially modified. It seems to be pretty well assured that the lathe in the future will be largely used as a roughing out machine. The boring of holes is now done on the chucking machine; the accurate finishing of plain parts is performed on the grinding machine; repetition work is done on the screw machine; and polishing is transferred to a special department. By making the lathe very stiff, and by flooding the work with lubricant, high speeds and heavy cuts can be maintained, and a great deal of work can be done in roughing out, using unskilled labour, one man keeping two or three lathes in operation. It is found much cheaper to reduce parts in this way than by smith work, and Mr. Orcutt shows many examples of its profitable employment.

The turret lathe is one of the most valuable machines to be found in the modern machine shop, but the lack of skill and training in properly maintaining and using turret machine tools is the greatest obstacle to its more extensive use in all classes of manufacturing, both of the automatic and hand type. With the provision of high-grade tool makers a large amount of lathe work now done by skilled men is sure to be shortly done on the turret machine by comparatively unskilled attendants who will eventually beat the trained turner, in respect to output, accuracy, and uniformity.

Mr. Orcutt closes his paper by a discussion of the use of jigs, small tools, and details of work, and gives some thoughtful words concerning the proper education and training of workmen. Says he: "Politicians and writers are raving over the technical schools of Germany. Speaking as one who has for years been in contact with the product of the German technical school, the author has no enthusiasm nor admiration for their methods; at least, as far as mechanical progress is concerned. Technical education as taught to-day is useless except to a very small percentage of our mechanical workers. There is an immense amount of talk about scrapping old machinery, buying new plant and planning new shops, whilst the most important factor of all—men—is left to shift for itself. Yet all are asking the question, where can I get good men? Train them, is the answer. The means for doing this are in the hands of every manufacturer. In your own shops, on your own machines, with your own instructors in your own time; neither municipalities nor governments can do it for you. Manufacturers must establish systems of apprenticeship which include workshop experience under educational guidance."

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**The Profitable Sale of Electricity.**

It is now becoming generally recognized that the profits from the supply of electric energy depend not alone upon the purely engineering part of the enterprise, such as the station apparatus and outside equipment, nor even upon the management of the plant, but to a large extent upon the methods of charging for the electricity sold.

In the electrical supply business, a plant must be installed large enough to take care of any possible demands, and even under favorable circumstances the maximum load lasts for only a short period, so that during most of the time a large part of the capital invested in the plant is earning noth-

ing. The cost of supplying any quantity of electricity is made up of the fixed charges and of the operating expenses. The former must be incurred before any current can be supplied, and they go on whether any energy is sold or not, while the latter vary with the amount of electricity delivered to consumers. The various consumers use different quantities of electricity and for different lengths of time, so that the cost of supplying a unit varies with the consumers. The most undesirable consumers, from the station manager's standpoint, are those who use the current for only a short period and at the time of maximum load and so increase the "peak" of the load line, while an ideal consumer would be one who took a uniform supply for twenty-four hours of the day and for three hundred and sixty-five days of the year.

The object of the station manager being, then, the attainment of a level load line, it becomes of great importance to inquire whether any method of charging for current can further this object, and a recent paper by Mr. Arthur Wright on "Some Principles Underlying the Profitable Sale of Electricity," read before the Institution of Electrical Engineers, gave a very full exposition of his views and led to a discussion in which a great variety of opinion was expressed.

The author says that before methods of charging for electrical energy can be properly examined, some approximate idea of the cost of generating and distributing it under varying conditions must be obtained, and a large part of his paper is taken up with this part of the subject.

"The cost of supplying electrical energy from a power station can generally be seperated into two very clearly defined groups —viz.: (A) The cost of *getting ready* to supply and distribute energy. (B) The actual cost of *continuing to do so*. These two groups the writer will call, for convenience, *preparation* and *production* costs respectively. The *preparation* costs may be divided into three sub-divisions: (1) The annual cost of the initial capital required to start the undertaking, or the *preliminary* or *formation expenses*. This has generally no very definite relation to the amount of business expected to be done. As the business grows, the annual charge to individual consumers to cover this item of expenditure most obviously rapidly diminish. (2) The annual cost of having to provide and maintain the plant and mains in a condition ready to supply and distribute electricity. These *standing-by costs* vary roughly with the annual maximum load to be provided for. (3) The cost of maintaining the necessary service lines, meters, and attending to consumers' accounts, complaints, and collecting the revenue. These *service costs* are roughly proportional to the number of consumers.

"The *production costs*, or the costs of continuing to produce and deliver electricity to the consumer, are those which actually vary with the amount of electricity distributed from a given power station and set of mains. The production cost per unit sold may be defined as the increment of expenditure incurred by making a given set of plant and mains supply an extra unit of electricity. It can only consist of the following items: (1) the inclusive cost of fuel necessary to produce and deliver this extra unit of electricity to the consumer's premises; (2) the cost of the fuel necessary to keep the steam dynamos running longer per day; (3) the cost of the extra water and oil used, owing to the longer run of the plant and the greater amount of energy supplied; (4) possibly some extra wages cost due to stokers and engine attendants having to work slightly longer per day; (5) the cost of that extra wear and tear of part of the plant which is solely due to the continued running."

The author lays particular stress on the relative smallness of the production costs to those of preparation in most electrical supply businesses, and then proceeds to discuss methods for determining their approximate values for a completed power station which has reached the steady extension stage when additional plant and mains have to be put down year by year to meet the increasing business.

"Although we can thus obtain a fairly accurate analysis of the various items making up the cost of supplying electricity as a whole from the mains, yet before a true profit and loss account can be prepared, we must determine the cost of supplying the individual consumers, and to do this many further considerations have to be taken into account. In the first place, how should the standing-by charges be divided among the

consumers, having widely varying requirements as to the amount of plant and mains required for their individual service? The writer thinks most power-station engineers will now agree that it is fair to debit each consumer with the same proportion of the total standing-by charges, as the amount of plant required for his supply during the evenings of the winter months, when the station experiences its annual maximum load, bears to that which would be required to supply the consumers should they all make their maximum demands simultaneously. As to the most practical method of determining the amount of plant, etc., so required by each consumer there are many opinions. Theoretically the best way of determining this data is no doubt some means by which every consumer's daily load curve can be taken and studied, but as this is commercially impossible, the writer is convinced that the next best way is to follow Prof. Kennedy's suggestion of supplying each consumer with a maximum demand indicator, and to make its rate of recording sufficiently sluggish to prevent the registration of any call for current for only a few minutes' duration. In a purely lighting business the majority of the consumers will make their maximum call for plant during the two or three hours in the winter days during which the whole of the plant is most heavily loaded, so that by taking the mean of the six winter months' maximum records so measured, a fairly accurate estimate can be obtained."

The author is the inventor of such a maximum demand indicator, which thus automatically determines what proportion of the plant must be at the service of each consumer. The tariff is then adjusted so as to make the consumer pay his proper share of the "preparation costs," and in addition, pay for the current he actually uses.

Two forms of tariff are proposed. The first is: A charge of x pence per unit for that part of the consumption which is equivalent to the use of the consumers' maximum demand for n hours per year (or quarter or month), and y pence for any further consumption in the said period. The second form is: A yearly or monthly rent per lamp used at the time of maximum demand, and a charge of z pence per unit for the electricity actually consumed.

The second form is very much like the tariff proposed by Dr. John Hopkinson, who was the first to enunciate the principles on which Mr. Wright's system is based. The first form is carried out practically by charging an initial high price per kilowatt-hour on a number of kilowatt-hours equal to the product of the maximum kilowatts demanded at any one time during the period under consideration and a fixed number of hours per day, say one hour or one and a half. The rest of the energy consumed is then charged for at a very moderate rate. Another way of stating the method is to say that there is a low fixed rate per unit on the total quarterly consumption, and in addition, an extra charge in proportion to the maximum amount of current demanded at any one time during the quarter.

The object of this system is to induce consumers to keep their maximum demand as low as possible and to encourage a steady and long-continued use of current.

Mr. Wright's argument is based very largely on experience in the lighting business, in which the load line has a very high peak in the early evening hours. Where there is a large day consumption of energy by motors, or where the load line is levelled in other ways, the benefit of a varying and complicated system of charging is practically lost. In fact, the variation and the complication of the Wright system were the chief objects of attack in the discussion which followed the reading of the paper. The general consumer cannot comprehend the principles upon which the system is based, and he cannot understand at all why his bills have such wide and apparently such inconsistent fluctuations. These objections have led to modifications of the Wright system, with a view to simplifying it, while still preserving the essential principles. At Hastings, for instance, a consumer pays an annual rental of ten shillings per lamp, and, in addition, one and one-half pence per kilowatt hour of energy.

Mr. Wright apparently does not attach enough importance to the storage battery as a load equalizer, while, as a matter of fact, in direct current stations, and in alternating systems with rotary-converter sub-stations accumulators can be employed with a storage capacity large enough to permit much of the machinery to be run continuously at

its normal load, when the necessity for any other rate than a straightout flat one disappears.

Mr. Wright's whole method aims to make the tariff for each consumer equal to the total cost of supplying him, plus a fixed profit. There is another principle upon which a system might be based, and which in the long run might result in the "greatest good to the greatest number," if it could be properly applied. That is, making each consumer pay for the current in proportion to its utility to him, or, in other words, "charging what the traffic would bear." To a limited extent, the Wright system does this, but only incidentally, and it would be interesting to see how the "utility standard" would work out when fully developed in practice.

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**High-Speed Steam Engines.**

THE term high-speed as applied to steam engines is altogether relative in its meaning, engines which a few years ago would have been termed high-speed, being now well within the category of medium-speed, while what is high speed in one locality is by no means so in another place. It is also necessary to specify whether high rotative speed, or high piston speed is meant, so that the term is one which should always be qualified when used, so that the user's position may not be misunderstood.

In a paper recently presented before the Liverpool Engineering Society, Mr. John Davidson discussed high-speed steam engines in a very clear manner, confining himself to engines of the quick-revolution type, setting forth their advantages as they are employed in modern engineering practice; especially in connection with the driving of electric generators, and without indorsing all of his views upon this much-discussed subject, we review much of the interesting matter presented.

Mr. Davidson sets forth the general advantages of the high-speed engine as follows:

"Electric generators were first driven by engines of the slow revolution type through gearing—either ropes or belts, etc., but this arrangement is now in almost every case superseded by engines coupled direct to the generators, the majority being engines of the quick revolution type, and thereby the losses due to the intermediate gearing, viz., ropes or belts, have been entirely dispensed with. This means economy in steam consumption, space occupied, and initial outlay for plant. Of course engines for electrical work are not the only ones built of the quick revolution type, as engines have been constructed for many years past, and many are in course of construction, for driving propellers for torpedo boats, etc., where it is absolutely necessary to get the maximum power with the minimum weight of machinery. Engines built for this class of work are of the most excellent design, and the best material possible has been used in the construction of the same, and the author thinks he is safe in saying that the want of extremely quick revolution engines for torpedo boats has led to greater development in design of this class of engine, more even than in those required for electrical work; but there is one difference, and that is, engines for electrical work have to be able to work at their highest speed continuously, whereas engines for torpedo boats have only to work for short periods at full speed.

"The quick revolution engine has long since proved to be a success, and has come to stay, and for electric light and power, the speed at which the engine should revolve is now limited, in most cases, by the builders of the generators, and not by the difficulties expected due to high speed in the engine itself. Engines of the quick revolution type can be thoroughly relied on, and the wear of all parts has proved, after long experience, not to be excessive. An increase in speed in engines has been found to develop many advantages in the way of economy in steam consumption—this economy increasing as the speed increases. Some disadvantages, or what might be described or imagined as such by many people, are, of course, developed, but these are out-balanced by the advantages developed, so they really cannot be taken into consideration."

Comparing the engine of slow rotative speed with the high speed engine of the Willans or similar type, Mr. Davidson calls attention to the large number of parts of engines of the Corliss type, and to the increased size and cost involved in the slower speeds. The disadvantages of the horizontal engine are also set forth, although it is not mentioned that the vertical engine is by no

means limited to the high-speed type, and that nearly all of the recent large engines for generating sets in power houses are of the vertical type.

It is interesting to note that in the early history of electric lighting the generators required to be driven at high speed, and hence it was necessary to belt them from slow-speed engines, or design high-speed engines for direct connection. During the period in which the high-speed engine was being evolved a reverse transformation took place in generator design, and at present the large railway generators are constructed to be operated at about the normal rotative speed of large trip-valve engines, or from 80 to 100 revolutions per minute.

Meantime the advance in high-speed engines is making the high-speed dynamo hold its place longer than would otherwise have been the case, and many direct-connected generating sets with high-speed engines and dynamos are made and used with satisfaction. At the same time it must be noted that these installations are for the most part of but moderate magnitude, and that the large units, of 3,000 to 5,000 h. p., are equipped with slow-running engines and generators. It is interesting in this connection to note that one of the best known firms building high-speed engines in England is also making preparations to construct Corliss engines for large powers in addition to the existing facilities for making their excellent high-speed engine.

Mr. Davidson gives some data as to the steam economy of high speed engines, and these give an excellent showing. Thus a Willans engine of 400 h. p. showed a steam consumption of 12.49 pounds per h. p. hour, while a Belliss engine of 250 h. p. gave a steam consumption of 21 pounds per electrical h. p. hour, and a Browett-Lindley engine of 200 kilowatts size required 17.9 pounds of steam per electrical h. p. hour. These results compare most favorably with the economy of slow-speed engines, and when the smaller first cost of the high-speed engines is taken into consideration, the advantages of the quick-running engines, for the sizes for which they are adapted, will be seen.

The high mechanical efficiency obtained with engines of the quick-revolution type is mainly due to the perfect system of lubrication adopted, and the lightness of the parts. There are many other things, however, besides the mechanical efficiency of an engine, which have considerable effect upon the steam consumption per brake horse power, as, for instance, the following:

Jacketting of cylinders.

Whether the steam be superheated or saturated.

Surfaces exposed to atmosphere, and consequent loss due to radiation.

Method of governing adopted, whether throttle or automatic expansion.

Jacketting of cylinders appears to have very little advantage with engines of the short-stroke, quick-revolution type, and the quicker the engine runs, the less appears to be the advantage, so that now the majority of quick-revolution engine builders do not jacket the cylinders, having found that the gain resulting therefrom is not worth the extra expense entailed.

Superheating, of course, has a most beneficial effect in reducing the initial condensation practically to a minimum, according to the degree of superheat used. This applies to both quick-revolution and slow-revolution engines alike. Superheated steam, although used many years ago, appears to have been abandoned owing to the mechanical difficulties caused thereby in the engine itself, and has only recently been taken up seriously as something worth using, and whereby great economy might be obtained.

Respecting the areas of surfaces exposed for radiation and similar losses, on this point the quick-revolution engine scores heavily, and all that may be said here is that the quicker you run the engine the less the surfaces exposed; as the quicker the engine runs the less the size of cylinders required for a given power.

There appears to be little doubt of the advantages of both types of engines, each having its proper place according to the conditions of its operation. For isolated plants and for small stations, using direct-current generators the high-speed engine will probably be always well suited, while for the great stations, using large units of several thousand horse power, the heavier slow-running engine presents advantages which may continue to outweigh those which Mr. Davidson has so fully presented for the quick-running engine.

**Alloys of Copper and Tin.**

THE reports of the Alloys Research Committee of the Institution of Mechanical Engineers are rightly regarded as classical contributions to the modern store of knowledge concerning the constitution and properties of these important materials of construction, and to these we now have the appendix, as it is called, in the form of the paper recently presented before the Institution by Mr. William Campbell upon the alloys of copper and tin.

These researches were undertaken in order to investigate more fully the freezing point curve of the copper-tin alloys as published in the fourth report of the Alloys Research Committee, and to note the change of structure due to casting.

Without going too deeply into the technical side of this important subject, the general character of the investigations may be here discussed, and the methods of work described, together with some examination of the practical impurtance of the results to the engineer and constructor, while the metallurgist and physicist may well study the original paper as an example of painstaking scientific work.

The original curve of fusibility of the copper-tin alloys was determined by Le Chatelier, and was shown to consist of three branches, changes in direction taking place at 3 per cent. and at 75 per cent. of copper. The later investigations of Sir William Roberts-Austen have added other points to the curve which evidently indicate changes in molecular condition, and it was to investigate the nature and constitution of the alloys at these points that the investigations of Mr. Campbell were undertaken.

By polishing and etching various specimens, their physical constitution may be studied under the microscope, and the object of Mr. Campbell's researches was to prepare the various alloys which showed peculiarities in the cooling curve, and to examine them by the methods of metallography to discover, if possible, the causes of the peculiarities, or at least the structural conditions which accompanied them.

The apparatus used in the researches is fully described in the paper, and consisted of a pyrometer of the Le Chatelier type, the galvanometer reflecting a spot of light upon a scale which could be watched as the cooling took place, and the operation interrupted at any desired temperature. The method of operation consisted in the very careful preparation of the various alloys, their fusion in a double crucible, a smaller one being placed inside of a larger and the space between being filled with asbestos, so as to insure slow cooling. In this way the average time of the fall in temperature from 1,800° to 900° F. was about half an hour. When the melted alloy was removed from the fire, together with the outer crucible and lid, the thermo-couple of the pyrometer was pushed through a hole in the lid, into the molten metal. When the spot of light reflected from the pyrometer showed on the scale the desired temperature, the wires of the thermo-couple were withdrawn quickly, and the inner crucible and its contents plunged into cold water.

By this method a great number of specimens of varying content of copper and tin were obtained, each having been slowly cooled to a determined temperature, and then suddenly chilled, so as to secure the structure at that point, and these specimens were then polished and etched and examined under the microscope. A large number of engravings from micro-photographs of the various alloys accompany Mr. Campbell's paper, and these, with his comments, enable the researches to be intelligently followed. While the study of these must be left for the student who desires to follow the work in detail, some of the general conclusions may here be given.

There appears to be no doubt that most important structural changes take place in solid alloys as the result of heat treatment, and while it may be necessary for the microscopical examination to be supplemented by tensile and compression tests, before the results become fully applicable to the engineer and constructor, yet much of practical value is already shown.

In the course of the discussion, Mr. Milton, of Lloyd's, called attention to the value of the cooling curves of the various alloys as revealing the purity of the metals employed. The researches of Roberts-Austen indicate that in the case of pure metals the breaks which appear in the curves are perfectly horizontal, while with impure metals they are curved, or present rounded corners. The explanation is that at the temperature at

which the break occurs a certain number of molecules of a definite compound of copper and tin become solidified and when the temperature falls a few degrees a few others solidify, these being of a composition richer in tin than the first, and forming a layer around them. There are thus formed successive layers of increasing richness in tin, according to the rate of cooling.

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**The Testing of Steel for Girders.**

THE development of testing methods, and the general use of some form of testing machine at steel works at the present time, indicates a great advance over comparatively recent times, when but little accurate or reliable information could be had about the material which went into a given structure. At the same time there are a number of points which may appear to be of minor importance, but upon which, in fact, much of the value of the tests depends.

An article in a recent issue of *The Engineer* upon the testing of steel for girders, brings out some useful and practical features, which may well be repeated and emphasized here.

In the construction of steel girders, the material is usually furnished to the contractor by the steel maker, and tested in the presence of the engineer or his inspector. Here the question of the character of the test piece enters very materially into the reliability of the results. This leads the way to a divided responsibility, since the makers decline to assume responsibility for tests made after the material has left their works, and insist upon abiding by tests made upon their own machines by their own men. The engineer, on the contrary, holds the contractor responsible, and his inspector takes his specimens from the pieces which have been delivered to the contractor, and which may or may not be properly representative of the material as a whole, and these he sends to an independent testing firm or bureau, throwing the brunt of the results upon the contractor. Without throwing any reflections upon any one, it often appears that the testing machines employed by the engineer do not give as satisfactory results as those used by the steel makers. This may depend upon the way in which the machines are handled, or upon the test specimens, and in any case may become a source of dissatisfaction.

In many cases these difficulties are avoided by having the engineer's inspector stationed at the steel works, the material being accepted or rejected upon his reports, but these tests should also be subject, in part at least, to revision upon the machine of a third and independent expert.

It is granted that there should be some sort of a test of the material from each furnace charge, and in this matter the selection of the test specimens should have consideration. In many instances test pieces are taken from crop ends, shearings, and scrap, but there is no evidence that these faithfully represent the material which is under stress in the finished structure. It is not always fully established even that they are from the pieces they are supposed to represent. The most reliable method, but not the most economical, is to take one plate from each charge of the delivered material, and cut the test pieces from the body, the number of plates ordered including sufficient for this purpose.

In this connection attention may be called to the importance of using machines with recording attachments, so that each test piece may be accompanied with its own autographic record. The information conveyed by a record is so far in advance of the mere results of scale readings that no comparison is to be made, and the reliability of recorders now to be had, and capable of being attached directly to the test piece itself, independently of the construction of the machine, is such that there is no reasonable objection which can be urged against them.

In all these matters it is greatly to be desired that the work of the International Association for Testing Materials should be taken into consideration, and that the methods recommended by it should be accepted and used in practical and commercial work. Apart from the value of the work of the association in advancing methods the great importance of making tests in such a manner as to be comparable in all parts of the world is a sufficient reason for accepting the work of this association and standardising both the test pieces themselves, and also the methods of examining them.

# REVIEW OF THE CONTINENTAL PRESS

**The Prizes of the French Academy.**

It has long been the function of the French Academy to decide upon and to award various prizes which have been founded for the purpose of the encouragement of the arts and sciences, and the yearly announcements of these high distinctions are always regarded with interest by scientific men and by those who realize the important part which applied science plays in the conduct of life and the welfare of society.

Among the large number of prizes in the award of the Academy there are several which belong to the field of the work of the engineer. This is to be expected in the department of mechanics, but it is interesting to note that more and more those departments which formerly were ranked in the domain of pure science, are being honored for work which properly belongs to the field of engineering. Thus among the present announcements, under the classification of Physics, Chemistry, and the general prizes, will be found subjects belonging to the domain of the engineer, either as regards their present applications, or for their prospective importance in the immediate future.

Thus the special Extraordinary Prize of 6,000 francs in the Department of Mechanics is divided between Lieutenant Tissot, for his work on the utilisation of wireless telegraphy to naval use, and M. Marbec for his discussion of the computation of the strength of pipes subjected to high pressures. The method of M. Marbec is based upon the elastic theory, and treats of the stresses in the successive laminæ of the material.

The Plumey prize goes to Professor Boulvin, for his excellent work in connection with engineering education at the university of Ghent, and especially for the development of the temperature-entropy diagram and its application to the study of the economical performance of the steam engine. This award will be appreciated by all those who know the good work done by Professor Boulvin, and his paper on the influence of the mechanical laboratory, which will appear in an early issue of THE ENGINEERING MAGAZINE, will be awaited with great interest, since the announcement of this award.

In view of the present interest in all that relates to the development of the steam turbine, it is worthy of note that no one of the papers submitted for the Fourneyron prize for a theoretical or experimental study of the steam turbine was thought worthy of award, so that the prize will go over until 1903.

The Montyon prize was awarded to M. Aimé Witz for his general good work in applied mechanics, and those who know the extent of his contributions to applied science will agree in the justice of the decision.

Among the prizes in the department of Physics, the most important, the La Caze prize, was given to M. Curie, who, with his talented wife, has done so much to develop our knowledge of the existence of radiant energy, and to isolate new radiant substances. The Gaston Planté prize went to M. Boucherot, for his improvements in induction motors and for his researches in alternating-current machinery.

The Kastner-Boursault prize for the application of electricity in the arts, was awarded to MM. Gall and de Montlaur for their development of commercial electrochemistry, especially in connection with the electrolytic manufacture of the chlorates of potash and soda. It has been largely due to the efforts of these engineers that the important industry of electrolytic chemistry has been developed in France, resulting in the utilisation of many sources of water power in Savoie and Dauphiné, the present electrolytic production of chlorates in France exceeding 6,000 tons annually, this replacing products formerly imported from England.

An award indirectly connected with en-

gineering is that of the La Caze prize for Chemistry to MM. Wyrouboff and Verneuil, for their work in connection with the isolation of cerium, didyium, and lanthanum from their minerals, together with the investigation of new minerals in which these metals are found. The importance of a full knowledge of the minerals used in the manufacture of incandescent gas mantles is of such importance in connection with lighting by gas and by petroleum and alcohol vapour, that it passes beyond the domain of chemistry and becomes of general technical value.

It has often been questioned whether the offering of prizes really tends to stimulate invention or research, and this point is still open to debate. In fact, nearly all the subjects which have been honored by the awards of the Academy have been undertaken for other ends than the gaining of academic prizes, these rewards coming later. At the same time the fact that the labours of scientific men are ranked with those of the other learned professions in the estimation of the highest tribunal of the nation cannot but have a beneficial general effect upon the ambition of all who devote themselves to science, however disinterested their immediate labours may be. Such a recognition then is to elevate the profession before the entire nation and furthers its work in directions in which it might otherwise be little known.

It is interesting to note that nearly all the subjects which have been selected for award have been discussed and reviewed at length in the columns of this Magazine during their development, so that its readers will find both names and subjects not unknown to them.

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**Measurement of Engine Speeds.**

We have referred in these columns more than once to the increasing attention which is being paid to the closer regulation of the angular velocity of steam engines, this, in some instances, such as the parallel running of alternators, being of more importance than the maintenance of a uniform mean rotative velocity. Various methods have been devised for computing the varying turning moments in engines of different kinds and with one or more cylinders, but the number of elements which must be taken into account renders the accurate computation extremely difficult. Thus there is the varying pressure of the steam on the piston, the varying effect of the inertia of the reciprocating parts, the angular action of the connecting rod as well as its swing in a vertical plane, also the effect of the unbalanced rotating masses attached to the shaft, and all these have to be reduced to the equivalent turning moments at each position of the crank.

In order to check the results of computations, various methods of recording the actual variations in angular velocity have been tried, and the whole subject has recently been presented in a discussion before the Société Internationale des Electriciens, published in the *Bulletin* of the society. From the interesting discussion we may refer especially to the communication of M. L. E. F. David, which from the simplicity of the method described should be extensively known and used.

M. David begins by discussing the variations in the impelling forces acting upon the crank, and examines a number of indicator diagrams, showing the effect of various points of cut-off. With these he examines the effect of the reciprocating parts, and describes the method of reducing the forces to diagrams representing the variations in turning moment on the crank throughout a whole revolution.

If we imagine a crank revolving at the same number of revolutions per minute as the crank of the engine, and having an absolutely uniform angular velocity, this crank being placed by the side of the actual crank of the engine, we can understand that the engine crank would gain or lose in position over the uniformly moving crank. crank. When the turning moment was in excess over the resistance the engine crank would gain, and when the resistance was in excess the crank would lose in position over that of the ideal crank. At any point in the revolution there would be an angular difference in the positions of the two cranks which would be a measure of the difference in angular velocity at that point.

M. David has attempted to devise an apparatus which shall enable these conditions to be realised in practice, and with an excellent measure of success. Briefly, his device consists of a disc attached to the end

of the crank shaft, and revolving with it. On the face of this disc, which is about 9 inches in diameter, there is produced an annular surface of smoke and against this smoked surface there is pressed a small stylus attached to one of the prongs of a tuning fork. The vibrations of the fork thus trace waves upon the smoked surface, the amplitude of the waves depending upon the force of the vibrations, and the length upon the speed of rotation of the disc. Since the fork emits a constant note, the successive waves indicate uniform intervals of time, and if the rotation of the disc were uniform the waves would be of uniform length. By removing the disc and fixing the record on the smoked surface by spraying varnish upon it, a graduated circle with equal divisions may be drawn upon the paper, and also radial lines corresponding to equal numbers of waves, the variations between the uniform graduations and those representing equal numbers of waves giving the angular speed variations for the corresponding parts of the revolution, and the speed of the engine may thus be compared with uniform rotation very closely.

M. David gives a number of such records in his paper, and, when studied in connection with the corresponding operating conditions, some very instructive information.

The paper is also especially thorough in its examination of the influence of the weight of the reciprocating parts upon the turning moments upon the crank. Especially interesting is the examination of the effect of the weight of the reciprocating parts for varying loads. A weight which may have an excellent corrective influence at the normal load may become a source of marked perturbations for light loads and early points of cut-off.

In general, the results given by the recording apparatus of M. David show greater angular variations of speed than are indicated by computation. This is to be expected since there are numerous small factors which cannot be taken into account in the computation, but which make up an aggregate sufficiently great to have a perceptible effect. The point of cut-off is not of uniform duration, nor is it the same for both ends of the cylinder, the frictional resistances are not constant, there are variations in steam pressure and vacuum, and in the dryness of the steam, while there are vibrations of the governor and the elasticity of its connections and of other parts of the machinery, and all these enter into the final result, although most of them are impossible of separate determination.

With such a method of record, in which all the elements of speed variation are collected into a final record of the actual effects, the whole subject should be placed in a form for careful study, and the results of various methods of improvement may be put to actual test and record, and the result should be apparent in the practical influence upon steam engine design.

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**Superheated Steam.**

A RECENT paper by M. Nolet, upon the principles involved in the use of superheated steam, is review at length in *La Revue Technique*, and the treatment is so comprehensive that some extracts are here given.

In the first place he calls attention to the imperfect general understanding existing among many as to the real condition of the medium which we call superheated steam. There is no doubt as to what is meant by the terms solid or liquid, but when we come to the expressions "the state of vapour" and "the gaseous state" there is room for misunderstanding.

When water is boiled in a closed vessel until it is entirely vapourised, the steam, from the time it begins to form, is saturated; that is, it possesses the temperature due to its pressure. If after the water is entirely evaporated, heat continues to be supplied, the steam becomes first dry, and then, assuming the pressure to remain constant, the temperature and the volume increase, and the steam becomes superheated. Superheated steam, then, has a temperature higher than that due to its pressure, and in this new state it possesses the same properties as a gas. As a matter of fact the so-called permanent gases are really vapours considerably superheated above their points of saturation.

If now we take the superheated steam, and subject it to the reverse operation, we observe two interesting phenomena. As heat is abstracted the temperature falls without any change in the state occurring. When, however, the temperature due to the

pressure is reached, any further abstraction of heat produces a very marked change, it being impossible to remove heat without a portion of the steam being reduced to the liquid state, or, in other words, becoming condensed, and a continued abstraction of heat will result in the return of the steam entirely to the liquid state.

The same conditions, reproduced in the cylinder of a steam engine, will produce the same effects. What, then, will be their influence upon the economical performance of the engine?

From the time the steam leaves the boiler until it is rejected from the engine, a continual abstraction of heat is going on. After the inevitable loss of heat in the pipe through which it passes on its way from the boiler to the cylinder, the steam, at the moment of admission, comes into contact with the walls of the cylinder, always much lower in temperature, since they have been cooled by the exhaust steam which has just left them, and it has been shown experimentally that the initial condensation may range from 20 to 40 per cent. of the total weight of the steam admitted. At the point of cut-off, therefore, instead of finding dry, or saturated steam in the cylinder, capable of giving the best results, there generally exists a mixture of steam and vapour of water.

Many attempts have been made to remedy this state of affairs, among which may be mentioned the use of the steam jacket, by which a fresh supply of heat is given through the lining of the cylinder.

The use of multiple expansion, in two or more cylinders, has also been extensively used, this preventing the incoming steam from meeting directly the walls which have just been cooled by contact with the exhaust steam. All such methods, however, are but palliatives, acting after the harm has been done, and capable of remedying it in part only.

This whole subject was investigated very thoroughly by Hirn and by the studies of the Ecole Alsacienne, and the result showed that the heat balance deduced from the heat exchanges going on in the cylinder invariably indicated a material loss of useful work.

The true remedy for these losses appears in the superheating of the steam before it enters the cylinder, thus permitting the inevitable reduction in temperature to affect the temperature of the steam without affecting its state. Hirn expressed himself in this respect in no uncertain terms. In his Théori Mécanique de la Chaleur, he says: "In the more or less remote future, when a sensible and rational progress in applied mechanics shall triumph over mere routine, the use of superheated steam will inevitably replace that of saturated steam, especially in cases where economical power is demanded." Since the time of Hirn, these principles have been advocated by Sainte-Claire Deville, Troost, Wethered, Siemens, and many others equally celebrated, and within the past few years the use of superheated steam has gained many advocates among practical men.

The principal practical difficulties which have been encountered in the use of superheated steam have been with the apparatus for superheating, and with the action of the highly heated steam upon the valves, packing, joints, etc., of the engine. For these reasons, superheating, which was tried extensively in England from 1850 to 1860, was then given up; but, as M. Nolet well puts it, it was not superheating, but rather superheating apparatus, which was abandoned.

At the present time there are several superheating devices in the market, designed upon scientific principles, and capable of providing steam superheated at least 200° C. above the temperature due to the pressure. Lubricants are readily obtained which will resist these temperatures, and with engines, designed for the use of superheated steam no difficulties are experienced in daily operation. The steam and fuel economy obtained by the use of superheated steam reaches 20 per cent., and in many instances this economy enables one or more boilers in a battery to be dispensed with, thus effecting an additional economy in the labor of firing.

In this connection it may be worth while to call attention to the fact that in engines for use with superheated steam the disposition of metal in the cylinders and valves may have an important effect upon the satisfactory working. Engines in which heavy masses are cast in one piece with the body of the cylinder are apt to be warped out of truth by the heat, while large flat slide

valves, or long Corliss valves, may be found difficult to keep tight. The best results are obtained with poppett valves which open by direct lift without any sliding action, and with care such valves may be so arranged as to permit a uniform heating of the entire cylinder and valves chest. It is interesting to note that the steam turbine, by reason of its entire freedom from rubbing surfaces, or the need of any sort of lubricant, is the best type of engine for use with superheated steam, and experience has shown that a marked economy results from its use.

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**The Transformation of the Merchant Marine.**

In an exhaustive review of the present situation of the merchant marine of the world, presented before the Eighth Congress for Navigation by M. Vétillart, and published in the *Annales des Ponts et Chaussées*, the transformation which has been made in recent years is especially discussed, and the limitations imposed by existing port facilities are brought out.

M Vétillart prefaces his paper with the statement that the present La Barre dock at the port of Havre was built in the same year (1807) in which Fulton started the Clermont on her trips between New York and Albany; the entrance of this important dock, which has served from that time until the present, being 13.64 metres (44.75 ft.) wide at the top, 11.69 metres (38.35 ft.) at the bottom, and with a depth of 6.70 metres (22 ft.) over the entrance still at mean high water. These dimensions were ample for the vessels of that day, the breadth then rarely attaining 10 metres, and the draught being less than 5 metres.

In 1899 the plans for a new dock were commenced, and work upon it has since been begun. This will have a width of 30 metres (98.42 ft.), and a length of 240 metres, 787.4 ft.), with a maximum depth of 9.65 metres (31.66 ft.) over the sill at high tide. These dimensions will admit vessels similar to the Oceanic or the Ivernia, of which the displacement exceeds 20,000 tons.

These figures indicate the changes which have taken place in the dimensions of merchant vessels during the past century, and indeed most of the increase has been in the last quarter of the century, while it is still progressing, and bids fair to continue.

Reviewing the causes which have led to the increase in the dimensions of merchant vessels, M. Vétillart rightly attributes it primarily to the advent of steam navigation, but there are also other conditions both constructive and commercial, which have aided in the growth in the dimensions of ships.

In the early history of steam navigation steamships were used for voyages of moderate length only, but with the improvements in the propelling machinery, securing such an economy of fuel that the eceonomical steaming radius was greatly increased, the use of steamships for heavy cargo transport over long distances introduced a new factor in marine traffic. Apart from the commercial importance of providing large vessels, the relation between size of hull and proportional power required for propulsion enters into the problem. The greater relative economy of motive power to burden in large vessels has contributed largely to the increase in dimensions, and in the competition for ocean freights the large cargo steamer has easily taken the lead.

The limitations of port facilities having been early reached as to width and draught, it remained only practicable to increase the displacement by increasing the length. In the early sailing vessels the ratio of length to beam was almost always included between 3.60 and 3.80. Some of the fast clipper ships were made of a length equal to 4.5 to 5 times the beam, and in the last of the wooden transatlantic steamers the ratio of length to beam reached 6 to 7. At the present time, with steel construction, the ratio has increased to 10 or 11, the limit mainly being found in the increased tendency to vibration, injurious alike to hull and machinery, besides causing discomfort to the passengers.

Among the changes which may be noted in ship construction during the period covered by the paper of M. Vétillart is that of the modification in weights. The introduction of iron for the hull construction caused a reduction of about 10 per cent. in weight over that of a wooden hull of the same displacement, and the use of steel caused a further reduction of 10 per cent. The old wooden hulls weighed about 50 per cent. of

the total displacement, while the present steel cargo steamers weigh about 30 per cent. of their displacement. The hulls of the modern transatlantic liners weigh about one-half of their total displacement, but this is due to the numerous bulkheads, and the general solidity demanded for the high speeds and heavy stresses to which they are subjected.

The machinery of the earliest steamships, operating at very low pressures and slow speeds, with rectangular boilers, weighed about 800 kilogrammes (1,760 pounds) per horse power! Even as late as 1860 the weight was as high as 500 kilogrammes (1,100 pounds) per horse power. At the present time the weight of the propelling machinery in the express steamers is about 250 to 300 kilogrammes (550 to 660 pounds), and in the cargo steamers about 200 kilogrammes (440 pounds) per horse power. There has thus been made a reduction in weight to one-third or one-fourth that of 40 years ago. Of course far greater reductions have been made in the weight of the propelling machinery of torpedo boats and destroyers. Thus, for example, the machinery of the Forban, by M. Normand, weighs only 16.7 kilogrammes (36.8 pounds) per horse power; about equally divided between the engines and boilers. These reductions in weight have been obtained by several means, among which may be mentioned; the substitution of the screw propeller for the paddle wheel; the introduction of high-speed direct-acting engines, in place of the older, slow-moving machines! the substitution of cylindrical boilers, and consequent increase in steam pressure; and the use of forced draft.

To these should be added the improvements in metallurgy, by means of which stronger and better materials of construction have been provided; permitting the use of steel castings and forgings, the use of nickel-steel, etc.

A most important advance is that which has gradually been made in the consumption of fuel, this affecting not only the economical performance, but also the space required for the carrying of fuel.

The early low-pressure engines required about 28 kilogrammes (62 pounds) of water per h. p. hour, and 4.5 kilogrammes of coal (10 pounds). At the present time the propelling machinery of ordinary cargo boats requires but 7 to 8 kilogrammes (15.4 to 17.6 pounds) of water per horse-power hour, and a consumption of but 0.8 to 1 kilogramme (1.76 to 2.2 pounds) of coal.

The progress in fuel economy may be attributed to the use of the surface condenser, to the use of improved boilers, and the employment of multiple-expansion engines, thus permitting the production and utilisation of much higher steam pressures than formerly, as well as higher degrees of expansion without proportional loss from cylinder condensation.

M Vétillart deduces formulas for the various relations between size, speed, power, fuel consumption, etc., from which it is possible to determine the most advantageous arrangement for any required service, and a study of this portion of his paper should lead to the application of scientific principles to questions hitherto considered almost wholly commercial.

The result of all this progress which has been made in the construction of large merchant steamers is the realisation of the necessity for the improvement of harbours and channels. Those ports which desire to secure or retain the commerce of the world must provide a depth of at least 9 metres of water (29.5 feet) and indeed great freighters such as the "Pennsylvania," when fully loaded, draw 9.75 metres (32 feet), and unless provision is made at existing ports for the accommodation of such vessels, it must be expected that the traffic will go elsewhere. It is to the engineer that commerce must look for its progress in the immediate future, as it has many times in the past.

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**Experiments on the Propulsion of Ships.**

THE great value of the testing tank as a means of obtaining data for the powering of ships and for the comparison of various hull models, is now firmly established, and a number of such tanks are in constant use in Europe and America. These tanks thus far have been operated upon the method originally suggested by Froude, the hull being modelled in paraffine or wood and drawn through the water by mechanism which measures the resistance of the model and the speed of its motion. The relation of these measured quantities to those for the

full sized hull may be reduced to formulas for ready application, so that the resistances for various speeds may be experimentally determined, and the powering, or the influence of changes in model, be practically studied.

The information obtained by this method, while of the greatest value, does not reveal anything about the behaviour of the propeller, but leaves this to be deduced from the resistance of the hull.

It is now proposed by Ing. Nino Pecoraro, in a paper in a recent issue of the *Rivista Marittima,* to provide models in the testing tank with screw propellers, driven by electric motors, thus enabling the propelling forces to be determined in terms of the revolutions of the propellers. In this way it is proposed to determine points in curves which shall show the number of revolutions of the screw corresponding to various speeds, and also curves showing the efficiency at different velocities.

The earlier experiments in this direction, made in the testing tank at the arsenal at Spezia, did not have the propeller mounted on the model. Instead, the propeller was carried by a light framework carried on overhead track, the motion being transmitted by a vertical shaft extending down into the water, and connected to the propeller shaft by a pair of bevel gears. The propeller thus pushed the model along, but was itself carried by the separate framework. This method naturally introduced disturbing factors, such as the resistance of the water to motion of the shafts and gears, as well as to the immersed portion of the framework by which they were carried. The errors have been entirely eliminated by the improvement of placing an electric motor in the model, the current being taken from feed wires running the entire length of the tank, the regulation being controlled entirely by the observers. The power supplied may be measured electrically to a high degree of precision, and the speed regulated and recorded, both as to the revolutions of the propeller and the speed of the model. Since the resistance of the latter may be previously determined by towing it in the usual manner, the efficiency of the propeller is given, and experiments may easily be made with propellers of various forms.

Signor Pecoraro gives details of tests made at Spezia with two models about 14 feet long, one having a single screw and the other provided with twin screws, and comparisons between these models using the older apparatus with the propellers suspended from the separate framework, and the improved arrangement with motors in the models, showed the losses due to the resistance of the suspended apparatus.

The paper contains a mathematical analysis of the relations between the model apparatus and the full sized ships, and numerous curves are plotted to show how general results may be obtained from a limited number of experiments.

The application of the testing tank to the study of the action of screw propellers cannot but furnish much valuable information in connection with the propulsion of ships. Although a vast amount of study, theoretical and practical, has been given to the screw propeller, the real performance of any screw is uncertain until it has been placed in the ship and given an actual trial. If the effect of diameter, speed, pitch, shape and surface upon the performance of a screw propeller can be obtained in the testing tank; and, furthermore, if this knowledge can be obtained in connection with the actual resistance of the hull in which the screw is to be placed, one of the chief elements of uncertainty in the predetermination of the speed of a proposed vessel will have been removed.

The trials in the testing tank should supplement, not replace to mathematical study of propulsion, and in no case should such a useful auxiliary be permitted to replace analysis, and allow the indiscriminate use of empirical methods of design and proportion; rather should the experiments be used to check and confirm the theoretical deductions, and be guided by them from inception to conclusion.

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**Water-Tight Compartments on Ships.**

WITH the increasing size and speed of steamships there has come increased attention to the details upon which depend both strength and floatibility, the importance of freedom from disaster being fully appreciated both by constructors and by the travelling public.

Among the recent propositions for improvement in the construction of ships, we

note the recent paper of M E. Duchesne, presented before the Société des Ingénieurs Civils de France, and published in the *Mémoires* of the society.

M. Duchesne, by virtue of his long experience as expert engineer of the Bureau Veritas, as well as because of his wide acquaintance with all departments of marine construction, is entitled to an especial hearing, while the novelty of his ideas must not be permitted to deter the most conservative from a careful examination of their soundness.

A ship consists essentially of two distinct structures, one being a girder, resisting by its structural strength the action of the winds and waves, and stresses due to the motive power, the other, the hull, opposing by its tightness the entrance of the water to the passengers, merchandise, and machinery. Under the present system of construction these two structures, although independent in their functions, are combined in one and the same, the hull being at the same time the girder and the water-tight shell. The necessity of this combination is obvious for vessels of moderate size, and indeed in such cases it offers decided advantages over any other method, but with the increasing size of vessels the conditions become modified.

In the present system of construction each portion is dependent upon the other. If, by any accident the hull of the ship is damaged the water rushes in. In like manner the stresses which heavy seas necessarily inflict upon a long hull produce deformations which may cause serious leaks. The principal improvement which has been made is the introduction of a number of transverse bulkheads with water-tight doors; these, when closed, separating the ship into compartments limiting the inflow of water to the section in which the break occurs.

M. Duchesne proposes to separate the two elements of the ship to as great an extent as practically possible. The system which he advocates is really an extension of the present double-bottom construction, and contemplates the construction of a complete water-tight inner hull, about two-thirds of the length of the ship, and having a space of three or four metres between its bottom and the main outer hull. This inner hull is stoutly made and heavily braced within, and is connected to the outer hull by partitions and braces, these latter, however, being made of mild steel, and not so rigidly braced as to transmit excessive deflections to the inner hull. The outer hull, therefore receives the action of the waves, and is made amply strong to resist them as understood in present methods of construction, but should leaks occur through straining or buckling, or should there be a collision, the inner hull would afford perfect security against sinking.

The engines, boilers and all machinery, M. Duchesne proposes to place in the inner hull, together with a portion of the coal, sufficient for at least one day's run, while the remainder of the coal may be placed in the space between the hulls. This space is sufficiently wide to permit of its being used for cargo, passengers, etc., and in appearance it would not differ from the rest of the ship, except that there would be no general communication between it and the inner hull without going above the water line and again descending. All the first-class accommodations would be altogether above the water line, and in general there would be no external indication of the special construction.

The inner hull would contain the usual water-tight bulkheads, and a limited number of water-tight doors would afford communication between the inner and outer hulls for the passing of coal, etc., but these could readily be controlled by automatic mechanical appliances, such as are now employed in existing bulkhead arrangements.

There is no doubt that greatly increased safety would result from such a construction as that suggested by M. Duchesne, but it appears to have its limitations. In the first place it is adapted to large vessels only, since there would not be sufficient space in moderate sized ships for an inner hull large enough to float the entire structure. At the same time the advent of the large passenger steamer is sufficiently assured to render this point of minor importance. The question of additional cost would be met, M. Duchesne believes, by the higher prices which could be charged for transport on vessels known to be non-sinkable; and in support of this view he calls attention to the high prices which are now obtained on the larger and safer ships.

# REVIEW OF THE AMERICAN PRESS

**Industrial Education in America.**

At a recent meeting of the Engineer's Club of Philadelphia there was held a most instructive symposium and discussion upon the important subject of industrial education, with especial reference to the needs of the United States, and from the *Proceedings* of the club, we extract some of the more important points made.

The original papers of the symposium were contributed by Professor Edgar Marburg, of the University of Pennsylvania, Mr. S. M. Vauclain, of the Baldwin Locomotive Works, and Mr. J. M. Shrigley, of the Williamson Trade School, of Philadelphia.

Accepting the fact that the old apprentice system is obsolete, and deservedly so, the discussion proceeded on the lines of the necessary schools, and their co-operation with the machine and the building trades. The transformation which has taken place in those trades is necessarily reflected in the methods of education. As Professor Marburg well says: "Industrial education stands to-day where technical education stood a brief half-century ago. While the provision for the latter leaves little now to be desired, the former has been almost wholly neglected. The general introduction of highly specialized machinery, the standardization and endless duplication of parts, the centralization of work in enormous factories—all these influences have resulted, it is true, in a cheapening of the output, but also in the cheapening of the workman. The vast majority of so-called machinists to-day are in reality machine attendants. Year in and year out they are confined to the operation of some single piece of mechanism—a service requiring a modicum of experience and individual skill. Such men are, in fact, little more than automatons, pursuing a certain narrow course of duty in an all but mechanical fashion."

This side of the picture is not all, however, since the tremendous expansion of manufacturing interests has given rise to a demand for a much higher class of skilled artisans, men who understand how to care for the highly organized modern tools, and provide them with tools and equipment to enable unskilled labor to attend them. The increasing attention which is given to advanced systems of works-organization has also created a demand for men of suitable qualifications for the positions of foremen, superintendents of departments, and managers of works. The demand for competent men of these higher classes is far in excess of the supply. Such men require, in addition to a varied and extended experience in the shop, a sound knowledge of the fundamental scientific principles pertaining to their various lines of work.

The graduate of the technical school possesses the latter qualifications, but he has not the necessary knowledge of shop practice. As a rule such men are disinclined to enter the shop after they leave college, but look at once for higher positions and better wages, while at the same time the influence of the labor unions is exerted against the invasion of what they consider their proprietary domain, by such intruders.

Mr. Vauclain, speaking as the representative of a great engineering establishment, maintains that the workshop is the true manual training school, and holds that the public and high schools should furnish a thorough training in the fundamental principles of mathematics and the physical sciences, and that the manual training could then be well furnished in the workshops of the nation, if the latter would rise to their opportunities. In the Baldwin Locomotive Works, there are many young men who have entered for the express purpose of adding to their school or college training the practical shop experience which is needed to make them all round workmen, superintendents, foremen, and managers. During this training period they receive enough to pay their living expenses, and at the end of two

or three years they are far and away ahead of any apprentice under the old seven years' indentures. A special superintendent of apprentices is occupied in seeing that these young men are given the opportunities to learn the various branches of the work and that they are not kept too long upon any one branch because they have shown a special aptitude for it.

The general outcome of the symposium was that industrial education may properly be divided into two departments; first, the general foundation, consisting of a good school education, with such a thorough grounding in mathematics and the physical sciences that the pupil may thereafter be able to continue intelligently any future studies to which his work may direct him. This portion of the education should be furnished by the public, in the public schools. Second, the practical shop training, which it should be the clear duty of the manufacturers to give along with the employment which they can furnish to the bright boys who are to become their most valuable skilled workmen. The manufacturers are not to suppose that this is any act of philanthrophy on their part; on the contrary, they will become the chief beneficiaries of the system, since it is by this method that their demand for skilled workmen, foremen, and superintendents is to be answered.

Modern automatic machinery has undoubtedly made it possible for much of the old-time manual skill of the machinist to be replaced by the invariable product of the improved tool, and rendered it practicable for such tools to be tended by comparatively unskilled labor. At the same time the transformation has created a demand for labor of a much higher grade of skill, including a fundamental scientific training combined with such skill of hand as shall be capable, not only of performing the mechanical work, but of devising methods, of distributing the course of work through the shop, of accounting for every item of its cost, and of maintaining the entire equipment of an establishment up to the very latest standards of efficiency, capacity, and perfection of product. This is a degree of industrial training of which the advocates of the old apprenticeship system had no conception, but it is the demand of to-day and will be the realization of to-morrow.

**Smoke Abatement.**

THERE have been many attempts to enact and enforce smoke prevention ordinances in American cities, and those who are interested in such movements may well take courage at the success which has attended such efforts in two cities at least, in St. Louis, and in Cleveland.

The progress of the good work in St. Louis is discussed in a paper presented before the Engineer's Club of St. Louis by Mr. W. H. Bryan, and published in the *Journal of the Association of Engineering Societies.*

St. Louis is naturally a smoky city, not only because of its many and varied industries, but also because of its close proximity to the soft coal beds of southern Illinois, from which it derives much of its supply of fuel. These coals are most plentiful and cheap, but they leave much to be desired in other respects. They are high in volatile matter, moisture, and ash, and are low in calorific power, and are altogether favorable to the production of smoke, unless proper methods of prevention are adopted. It is naturally the duty of the engineer to encourage the use of the most economical fuel, and at the same time to show how the nuisance of smoke production may be avoided.

The Engineer's Club of St. Louis, with which Mr. Bryan has long been identified, has been most active in endeavoring to aid in the prevention of smoke within the city, and while always advocating the enactment of ordinances to further that end, its members have felt that the best work could be done by educating the public and by encouraging the development of improved furnaces. The whole idea of the work of the club was to show that the prevention of smoke by modern methods inflicts no hardships on industries, but may, on the contrary, conduce to increased fuel economy.

It is impracticable here to go into the local methods which were employed in St. Louis, other than to state that the combined efforts of a citizen's committee and of the Engineer's Club resulted in such a marked abatement of the smoke nuisance that it has been determined to make the smokeless burning of coal one of the noteworthy features of the coming Louisiana Purchase Exposition.

Broadly speaking, there are three methods of stopping the production of smoke: First, the shutting down of smoke-making plants; second, the use of smokeless fuels; third, the burning of ordinary fuels smokelessly.

Although it may seem that little good could be accomplished by the actual shutting down of plants, it really seems as if this method might ultimately result in the complete solution of the problem. Those establishments which were compelled to cease the production of smoke have for the most part introduced electric power, drawing their supply from the large central stations, situated at a distance, and provided with smoke-preventing appliances. Ultimately this indicates the removal of all power generating plants from the cities, and their location at the mines; the power being transmitted and utilized electrically.

In the meantime, various forms of smokeless furnaces have been introduced, with good results. Among these, Mr. Bryan mentions the following:

Steam jets, which are the simplest form of smoke prevention appliance; coking furnaces, with firebrick arches, enabling complete combustion to take place before the products of combustion are permitted to come in contact with the comparatively cool surfaces of the boiler; down-draft furnaces, in which the products of combustion are compelled to pass through the fire in the reverse direction from that usually followed; automatic stokers, including underfeed devices and travelling chain grates; and finally, powdered fuels. All of these may be shown to give good results, and in the city of St. Louis many of them have been installed with the result of rendering that city far freer from the smoke nuisance than would have formerly been considered possible.

The state of affairs in the city of Cleveland is well described by an article by Professor C. H. Benjamin, in a recent issue of the *American Machinist*. Cleveland has vied with St. Louis in being one of the smokiest cities in the United States, but thanks to the efforts of energetic citizens like Professor Benjamin, much of this clouded reputation has been removed. This result has been accomplished by the creation of a separate division of the city government having the matter in its sole charge. Under the supervision of Professor Benjamin, a thorough canvass was made of the entire city and an expert observer was detailed to report upon the worst smoky chimneys, the records being taken upon card index forms for filing and reference. The manufacturers were then approached and the subject discussed with them intelligently and carefully, without any attempts at persecution, especial emphasis being laid upon the economy which would be effected by good combustion.

The very small quantity of suspended carbon which is needed to produce dense smoke has been made a reason for statements that smoke prevention could not result in any material saving in fuel; but, as Professor Benjamin shows, the production of smoke is in itself an indication of imperfect combustion, and with the smoke there is also discharged a large proportion of carbonic oxide, this, although transparent, meaning a material loss due to the partial combustion of the fuel which it represents. The result of this campaign has been the introduction of improved furnaces and of better methods of firing, so that at the present time the smoke produced has been reduced to about one-fourth of its former value.

The experience in Cleveland has shown that the diminishing of the smoke nuisance has been accompanied with a reduction of 15 to 25 per cent. in coal bills, and this, as well as the interest of manufacturers in the welfare of the city has aided in the efforts to purify the atmosphere. This economy is the result, not only of the more complete combustion of the fuel, but is also in part due to the improvement in boiler efficiency by reason of the diminished fouling of the flues by soot.

There is little doubt that no more powerful incentive toward the abatement of the smoke nuisance can be offered than a demonstration of its fuel economy, and this has been fully demonstrated by the results in Cleveland.

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### The Supporting Power of Piles.

THE extent to which piles are used in important foundation work renders it most desirable that some means should be provided for determining the safe load which may be put upon them in any given case, and many authorities of high reputation

have produced formulas for such computations.

In a paper recently presented before the American Society of Civil Engineers, and published in the *Proceedings* of the society, Mr. Ernest P. Goodrich has collected these numerous formulas, and examining the assumptions and data on which they are based, he has produced a general formula in which the previous ones are included.

In order to demonstrate the errors and the reliable elements in the various formulas Mr. Goodrich has devised an apparatus for use with a pile driver which should record the vertical motion of the pile, the time occupied by this motion, the velocity of the hammer as it strikes the pile, and of the pile at each instant of its movement, and also the amount of compression of the head of the pile from the blow of the hammer. This ingenious apparatus is so arranged that the various movements are recorded by a curve drawn on a piece of smoked glass, while intervals of time are recorded on the same glass by the vibrations of a tuning fork of known period. Many such diagrams are given in the original paper, and the results compared with the computations of the formulas, the curves having been examined with a Coradi graphical integrating machine enabling the curves representing the differentials of the originals to be obtained.

The result of these investigations is the deduction of a formula which is far closer than any of the others, except Trautwine's, to the observed results, this formula, expressed as a rule, being that the supporting power in pounds is equal to ten times the hammer weight, multiplied by the height of the drop, divided by three times the penetration at the last blow.

Mr. Goodrich makes some recommendations regarding tests of the supporting power of piles, which if followed would make the results of various observers comparable, and enable the existing formulas to be revised or sustained. The principal point is that a uniform drop of 15 feet be adopted for the hammer, since this gives a good penetration within the limits of ordinary conditions, and is adapted for existing pile-drivers. The following specification is also recommended:

"Piles shall be driven to such depths that the last blow of a 3,000-lb hammer freely falling 15 ft., shall not produce a penetration greater than 1 in., or an equivalent penetration directly proportional to the weight of the hammer." It is believed that such piles will support an ultimate load within 10 per cent. of 75 tons; and that designers can more easily determine the necessary pile spacing and the most desirable factor of safety to be used in individual cases, and make the pile-drivers follow a standard specification, than otherwise.

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### The Bohio Dam.

In all of the discussions relative to the construction of the Panama canal, the Bohio dam has played a conspicuous part, and the magnitude and difficulties of this work have been set forth as important objections to the Panama route. For this reason the important paper of Mr. George S. Morison before the American Society of Civil Engineers, published in the *Proceedings* of the society demands especial notice at the present time. The eminence of Mr. Morison in the especial department of engineering to which this work belongs, and the fact that he is a member of the Isthmian Canal Commission, which has advocated the selection of the Panama route, lends especial value to his utterances.

Admitting that the neighborhood of Bohio is the only available location for the dam by which the summit level of the canal must be maintained, there are differences of opinion as to the precise location to be selected, and as to the manner in which the dam should be constructed.

The high banks of the valley are near together at Bohio, and the rocky character of the sides renders the location apparently an ideal one for a dam. Borings reveal, however, that the alluvial bottom has simply filled up an old deep geoligical valley, and that the lower portion of this valley, to a depth of 140 feet in some places, is filled with sand and gravel permeable to water.

The original plan of the French engineers was to build the dam at the narrowest part of the valley, opening the ground to a varying depth, not beyond what could be done with open coffer dams, and to build an earth dam of compact material, without a core wall. This dam was to be 15 metres wide on top, and the down-stream face was to be faced with rip-rap and the up-stream face

with concrete. A concrete wall was to be built across the river at the foot of the upstream face, this wall to be built between two lines of sheet piling. Such a dam, like other earth dams, would not be safe against an overflow, but would be tight in itself, and the only loss of water would be that which would percolate through the permeable material in the valley below the bottom of the dam.

The present Isthmian Canal Commission has adopted a plan of a dam intended to be absolutely tight in itself, admitting of no seepage either through, or below it. This involves the selection of the location showin the minimum depth to bed rock below, the borings indicating this to be 129 feet deep. The method of construction is proposed to consist of a series of pneumatic caissons, sunk to the rock, these caissons forming the foundation of a solid concrete wall, the two together constituting the core wall. This would undoubtedly make a most complete construction, but it would involve the extension of pneumatic work to unprecedented depths, and would be by far the most costly form of construction proposed.

The plan suggested by Mr. Morison is different from either of the preceding, but resembles the French design in that it proposes to permit the seepage to pass through the permeable soil beneath the valley. The general arrangement of the plan includes two rock-fill dams, one situated about 200 feet above and the other about 2,000 feet below the French location. The space between the two rock-fill dams would be filled with impermeable material, the two dams being retaining walls which would hold the earth in position. This would practically convert the dam, or rather pair of dams, into an extended piece of land, forming a shore or bank to the artificial lake thus formed. Two lines of sheet piling, driven as deep as practicable, probably about 50 feet, would be used below the first rock-fill dam, these preventing a large portion of the seepage through the permeable soil of the old valley, but below this the seepage would be permitted, it being not so much but that it would be made up by the stored supply of water, while the extent of the whole structure would render it safe against any destructive effect from this cause.

In any case there is provided a natural spillway over a low summit which separates the Chagres river from a local tributary, the Gigante, and there is an excellent site for the necessary construction works about 2 miles below the site of the dam.

Mr. Morison's paper contains sections of the various proposed dams, and a map of their locations, with details of the various estimates, as well as much valuable information concerning the temporary works necessary during the construction of the entire work. The whole forms a contribution to the literature of the isthmian canal projects which is refreshing in that it deals directly with the engineering problems, devoid of any speculation or sentiment, assuming that the Panama route is the true engineering solution of the question, and showing how what is considered its most difficult problem is one which has been thoroughly mastered in more ways than one.

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### American Fuel Oil.

THE extensive developments of the fuel-oil-wells in Texas, render the results of the report of tests made upon the fuel value of Beaumont oil by Professor Denton, of present interest.

The trials were made by using the oil for firing a steam boiler in a manufacturing plant in New York, and as the boiler was one of a battery which was also tested for results with coal firing, the data and results are of comparative value.

The boiler was of the ordinary return tubular type of about 1,000 square feet of heating surface, and was arranged for use with oil fuel by covering the grate bars with fire-brick, a checker work being built up on the back portion of the grate. The air was admitted through ducts of hollow tile, coming in through the ash pit front and delivered back at the bridge wall, and then coming front and passing up in front of the grate bars and passing back with the burning oil through the checker-work and so under the boiler and back through the tubes. The oil burners were placed in front of each of the two fire doors, the oil being blown in by steam jets, and a portion of the air supply also being drawn in at these points; the mixture of steam, oil, and heated air being delivered into the furnace and meeting the main current of air flowing up from the ash

pit. The boiler was operated from its normal capacity of 112 horse power to an over load of 220 horse-power, and the combustion appeared to be excellent, but little smoke being produced, even under the latter conditions.

The data and results of the tests are fully tabulated in the report, which is published in full in several of the technical journals, but some of the salient points may be mentioned here.

For a range of from 112 to 220 horse-power the total evaporation from and at 212° per pound of oil varied from 15.71 to 15.29 pounds of dry steam, and the burner consumption varied from 3.1 to 4.8 per cent. of the boiler output, so that the net evaporation ranged from 14.74 to 15.16 pounds of water per pound of oil.

The combustion of the oil by the burner was practically perfect, since by the evidence of the heat balance the heat accounted for by the steam production, the hot gases flowing to the chimney, and a reasonable allowance for radiation represents about 98 per cent. of the total heat of combustion of the oil when burned in oxygen in a calorimeter.

The boiler utilized about 78 per cent. of the heat of the fuel, which represents the best average boiler practice and the percentage of steam consumed by the burners is a minimum for steam-jet burners.

An excess of cold air probably caused a loss of evaporation for the smaller horse-power, but for the 189 and 220 horse-power tests there was no excess of the air necessary for complete combustion. Consequently for the two higher horse-powers the net evaporation of 14.8 pounds of water per pound of oil may be considered to represent the best economy that is to be expected from the use of the oil as a fuel with steam-jet burners.

The evaporation from and at 212° per pound of coal was 9.17 and 8.94 pounds of water for 93 and 119 horse-power. The coal afforded 11.6 per cent. of ash, and 14,680 B. T. U. per pound of combustible when burned in oxygen in a calorimeter, which represents an excellent No. 1 buckwheat. Considering that the coal was laden with 6.2 per cent. of moisture, and was consumed in the furnace to about 17 per cent. of ash, the evaporative results per pound of wet fuel are excellent. They correspond to an evaporation of 11.79 pounds from and at 212° per pound of combustible, which affords the very excellent boiler efficiency of 77.6 per cent.

We see therefore that the ratio of oil fuel to coal by weight for equal evaporation is 1.65 in favor of oil, 4.23 barrels of oil being the fuel equivalent of a ton of coal of 2,240 pounds.

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### The National Bureau of Standards.

A NATIONAL bureau of standards is by no means a new idea in the United States, but it is only recently that the project, which formed the subject of a report by Thomas Jefferson, when first Secretary of State, has taken definite form. In a paper in a recent issue of the *Journal of the Franklin Institute*, the Director of the Bureau, Mr. Samuel W. Stratton, gives an account of the newly established bureau at Washington, and outlines its projected work.

"According to the law enacted a year ago, the functions of the National Bureau of Standards include the custody of the official standards, and comparison of all standards used in scientific investigations, engineering, manufactures, commerce, and in educational institutions, with the standards adopted or recognized by the government, the construction, when necessary of standards, their multiples and submultiples, the testing of standard measuring apparatus, and the solution of problems which arise in connection with standards. It is also authorized to make physical and chemical researches for the purpose of determining physical constants, and the properties of materials when such data are of great importance to scientific or manufacturing interests. The Bureau is authorized to exercise its functions for the departments of the Government, for any State or municipality within the United States, scientific society, educational institution, firm, corporation, or individual engaged in manufacturing or other pursuits requiring the use of standards, or standard measuring instruments.

"A suitable site has been purchased by the Government adjacent to the picturesque national reservation known as Rock Creek Park in the northern suburbs of Washington, a locality free from mechanical and

electrical disturbances. Plans are being prepared for a physical laboratory which will be equipped with apparatus and conveniences for carrying on investigations and testing standards and measuring instruments of all kinds, and a smaller building to be known as a mechanical laboratory which will contain the power and general electrical machinery, the instrument shop, refrigerating plant, storage batteries, dynamos for experimental purposes, and laboratories for electrical measurements requiring heavy currents.

"These laboratories will be constructed immediately, but the plans are being made with reference to the future growth of the Bureau, which will soon become one of the most important scientific institutions of our Government. The plans will include at least four buildings in addition to those now provided for.

"The scientific work of the Bureau will be under the immediate supervision of a director, assisted by a corps of physicists and chemists designated as laboratory assistants, assistant physicists or chemists, and physicists or chemists with salaries ranging from $1,000 to $5,000. These salaries are somewhat more liberal than the Government has hitherto paid the scientific men in its employ. These men have been carefully selected by civil service examinations prepared with reference to the kind of work to be undertaken. No attempt has been made by politicians or others to influence the appointments in the Bureau, and the Bureau once established upon this basis, will, it is believed be free from political influence.

"The value of such an institution has been clearly demonstrated by nearly every government in Europe. England has established a standards department of the Board of Trade, also the electrical standardizing laboratory, and recently a physical laboratory; Kew observatory, an institution famous for its testing of meteorological instruments, has also become a Government institution. Germany has established the Normal Aichungs Commission, with its laboratories and facilities for handling commercial weights and measures, and in 1887, the Physikalisch-Technische Reichsantalt, an institution costing more than a million dollars, which makes provision for scientific standards and investigations. It has been frequently said that this institution more than pays for itself annually in the assistance it gives to German manufacturers and scientists. The scientific work of our own Government has received great benefit from this institution during recent years. At the hearing before the House Committee on Coinage, Weights and Measures in reference to the Bureau of Standards Bill, the Secretary of the Treasury presented letters from every scientific bureau in the Government, stating that they were compelled to go to this institution for certain standards. It was this fact, coupled with statements to the same effect from the prominent manufacturers, scientists and others present at the hearing, that led the committee to report unanimously in favor of the bill establishing the bureau. There is scarcely an interest in the country which will not be vitally benefited by this new institution. Its relation to foreign commerce will be far-reaching, and its establishment means that the United States has taken a long step forward in the international race for commercial supremacy."

Director Stratton calls attention to the opportunity which the establishment of this bureau offers for the introduction of the metric system in the United States. In any event the introduction of a decimal system of weights and measures is regarded as most important, and the universal adoption of the metric system upon the continent of Europe, and its probable adoption in Great Britain, render it desirable that its defects be overlooked, and that it be adopted in the United States for the urgent commercial reasons which have been presented.

In any case the establishment of a national bureau of standards will go far towards the general introduction of standard methods of measurement, the use of standard gauges, and the adoption of methods of interchangeable production. Much useless expense will be avoided, increased output will follow, and the position of the United States in the struggle for commercial supremacy will be materially strengthened.,

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**Electrical Illumination.**

"If by some new invention the energy required to produce one candle-power in illuminants of all classes could be cut down

to one-half its present value, the world would be in an uproar over it. But it is well within the truth to say that skilfully treated illumination will effect at least an equivalent saving, or will give vastly better results for the same expenditure of energy. Highly emcient radiants are *per se* very desirable, but if efficiency is gained at the loss of other important qualities, it may be dearly bought. Illumination, visual usefulness, is the thing to be sought."

These words give the key-note of Dr. Louis Bell's paper on "Methods of Illumination," with which he opened a topical discussion on "Methods of Illumination and Units of Light" at a recent meeting of the American Institute of Electrical Engineers. He discussed "the art of illumination from its human and practical side rather than the technical details of electric lighting, and compared methods as bearing upon the result rather than in their theoretical relations.

"Whatever the methods employed the end of artificial lighting should be to furnish illumination in quantity fully adequate for the conditions to be met, and in quality such as will neither unduly strain the eye nor in any way inconvenience the user. The three most important quanties for a practical illuminant are, in the order of their importance, as follows: 1. Steadiness. 2. Suitable intrinsic brilliancy. 3. Suitable color."

Dr. Bell thinks that "any source of light subject to rapid and frequent variations as great as five per cent. is unfit for use as an illuminant for work requiring steady use of the eyes. Much greater changes, occurring slowly enough for the iris to act with them, or at infrequent intervals, can be tolerated without inconvenience.

"Experience indicates that for radiants within the field of vision at the distances ordinarily met with in interior lighting an intrinsic brilliancy of five candle-power per square inch is about as high as it is wise for hygienic reason to go, and better rather less than rather more. This indicates at once for the radiants in common use that they should never be employed within the working field of vision without diffusing shields to keep down the intrinsic brilliancy.

"It is not necessary that artificial illuminants should conform to a particular color standard, save where color is a matter of prime importance. It is, however, true that the general applicability of a light is very strongly influenced by its hue, and that, broadly, strongly colored lights would fail conspicuously in visual usefulness.

"As regards artificial lights, generally supposed to fail conspicuously in giving what we are pleased to call "natural" color effects, every one of them, except the enclosed arc, which is strongly bluish, and the Welsbach, which is greenish, can be matched by normal sunlight at some time of the day. Even a Hefner lamp is not redder than a low sun on a hazy day. The ideal artificial light from a purely utilitarian standpoint should represent average sunlight, and as far as color is concerned, one can plan for artificial illumination with reasonable freedom of choice.

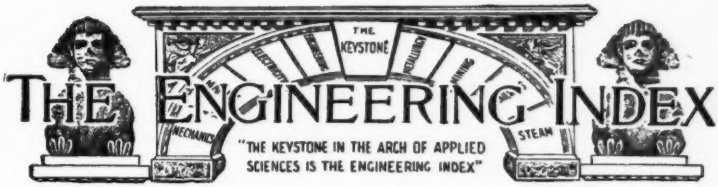
"As electrical engineers in dealing with problems of illumination we practically make use of the following classes of illuminants: Open arcs, enclosed arcs and incandescent lamps of various types and efficiencies, to which we must now add the 'Nernst' type of lamp. They vary widely in total power, in intrinsic brilliancy, in steadiness, in color and in efficiency, and all of these properties have to be borne in mind in adapting them to practical business."

Dr. Bell spoke of the benefit to be derived from even very simple reflectors, and showed a table giving photometric results with various types.

Mr. Peter Cooper-Hewitt read a paper on his mercury vapor lamps, which were used for lighting the meeting hall, and which have already been described in these columns; and there were other papers on street illumination, the incandescent lamp of to-day and standards of light.

One of the points brought out in the discussion was that arc lamps give fairly well distributed illumination in city streets, owing to the reflection from house walls, but that on country roads they are mere points of brilliancy in the darkness, wasting their brightness on the desert air, and that here incandescent lamps or even oil lamps might be better as far as visual usefulness is concerned.

All th· papers contained matter of practical interest, but the limits of space prevent more than a bare mention of them.




The following pages form an index to the contents of nearly two hundred of the leading engineering journals of the world, in English, French, German, Dutch, Italian, and Spanish, together with the published transactions of important engineering societies in the principal countries. It will be observed that each index item gives the following essential information about every article.

(1) The full title, (2) The name of its author,
(3) A descriptive abstract, (4) Its length in words,
(5) When published, (6) Where published.

We supply the article itself, if desired.

The Index is conveniently classified into the larger divisions of engineering science, to the end that the busy engineer and works manager may quickly turn to what concerns himself and his special branches of work. Thus this Index makes it possible within a few minutes' time each month to inform one's self of every important article published anywhere in the world upon the subjects claiming one's special interest.

The original of any article referred to in the Index, together with all illustrations, can be supplied by us. See the "Explanatory Note" at the end, where also the full titles of the journals indexed are given.

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# CIVIL ENGINEERING

## BRIDGES.

**Arches.**

Great Stone Bridges in the Grand Duchy of Baden (Grosse Steinbrücken im Grossherzogtum Baden). R. Moser. A well illustrated description of two fine stone arches, with spans of 64 meters and 57 meters, respectively, on a railway in Southern Germany. 4000 w. Schweiz Bauzeitung—Dec. 21, 1901. No. 45838 B.

The Determination of the Thrust in Masonry Arches (La Determination de la Poussée dans les Voûtes en Maçonnerie). M. Auric. Deducing formulas for the computation of the thrust for arches of

*We supply copies of these articles. See page 969.*

various dimensions and loadings. 6000 w. Ann des Ponts et Chaussées—2 Trimestre, 1901. No. 45817 E+F.

**Brooklyn Bridge.**

The Condition of the Brooklyn Bridge. Extracts from the Annual Report of the Commissioner of Bridges, from the special report of Messrs. Buck and La Chicotte. 6200 w. R R Gaz—Jan. 10, 1902. No. 45481.

The Official Report of the Condition of the Brooklyn Bridge. Editorial review of this report. 3200 w. Eng Rec—Jan. 4, 1902. No. 45340.

I. The Physical Condition and Safety Under Present Loads of the New York and Brooklyn Bridge. Gus C. Henning. II. Mr. Hildenbrand's Reply to the Report of Messrs. Duryea and Mayer on the New York and Brooklyn Bridge. Mr. Henning's letter is also a discussion of this same report. 17000 w. Eng News—Jan. 16, 1902. No. 45486.

**Comparison.**

Suspension and Cantilever Bridges. A discussion and comparison of these types, with remarks on the arch type. 2300 w. Engr, Lond—Jan. 17, 1902. No. 45780 A.

**Concrete Arch.**

A Three-Hinged Concrete Arch Bridge Over the Danube at Ehingen. Illustrates and describes this engineering work which possesses points of interest. 1400 w. Eng News—Jan. 9, 1902. No. 45370.

Concrete Bridge on the Gürbethal Railway, Switzerland (Betonbrücke der Gürbethalbahn). R. Moser. Illustrated description of a concrete arch, 23.4 meters span, for single track, near Bern. 600 w. Schweiz Bauzeitung—Dec. 14, 1901. No. 45836 B.

**Draw-Bridges.**

A Graphical Method for the Solution of Stresses in the Continuous Girder, as Applied to Draw-Bridges. Discussion of the paper by George F. Barton. 2000 w. Pro Am Soc of Civ Engrs—Dec., 1901. No. 45217 E.

The Little Calumet River Drawbridge. Illustrated detailed description of a double-track, through plate-girder drawbridge of 171 1/3 ft. span, in Illinois. 2000 w. Eng Rec—Dec. 28, 1901. No. 45229.

**East River Bridge.**

The New East River Bridge. Illustrations showing the present condition of the New East River Bridge at New York, with comments. 1200 w. Ir Age—Jan. 2, 1902. No. 45244.

**Girders.**

Erection of Girder Spans on the West Virginia Short Line R. R. Illustrates and describes some of the work on the West Virginia Short Line Railroad, a single-track line recently built to develop rich coal and oil resources. It is 60 miles in length and has 54 steel bridges and 3 tunnels. 4000 w. Eng Rec—Jan. 18, 1902. No. 45712.

**Highway Bridges.**

The Chippewa Falls Highway Bridge. Illustrated detailed description of a new through riveted-truss highway bridge, built to replace a narrower bridge, without interruption of traffic. 1600 w. Eng Rec—Jan. 25, 1902. No. 45741.

The Middletown (Conn.) Bridge—The Longest Highway Draw Span. H. G. Tyrrell. Illustrates and describes the superstructure and substructure. 2500 w. R R Gaz—Dec. 27, 1901. No. 45234.

**India.**

The Railway Bridge Over the Godavari River at Rajahmundry, on the East Coast Railway in India. Two-page plate and other illustrations of a recently constructed bridge of 50-spans of 150 ft. each, its total length being 9096 ft. over all. Detailed description to appear later. Engng—Jan. 3, 1902. Serial. No. 45430A.

**Laibach.**

Reconstruction of the Laibach Moor Bridge on the Southern Railway of Austria (Umbau der Laibacher Moorbrücke der Südbahn). F. X. Gürke. A very completely illustrated description of this bridge and viaduct across swampy ground, with details of construction. Also a description of Prof. A. Belar's apparatus for recording bridge vibrations. 3 plates. 7000 w. Zeitschr d Oesterr Ing u Arch Ver—Dec. 27, 1901. No. 45697 B.

**Lift Bridge.**

A New Scherzer Rolling Lift Bridge at Cleveland. Illustrates and describes a recent bridge over the Cuyahoga River, built to replace a swing bridge, because of navigation interests. 900 w. R R Gaz—Jan. 17, 1902. No. 45537.

**Prague.**

The Temporary Bridge over Hetz Island at Prague, Bohemia (Die Provisorische Brücke über die Hetzinsel in Prag). Rudolf Kaplan. A well illustrated description of the design and construction of a provisional bridge over the Moldau River. 1 plate. 4000 w. Oesterr Wochenschr f d Oeffent Baudienst—Dec. 14, 1901. No. 45691 B.

**Replacement.**

Chicago, Milwaukee & St. Paul Bridge at Minneapolis. Illustrated description of an important piece of replacement work over the Mississippi River. 800 w. Ry Age—Jan. 3, 1902. No. 45363.

**Strain Recorder.**

Apparatus for Recording the Local Deformation of Metal Pieces (Appareil En-

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registreur de la Déformation Locale des Piéces Métallique). MM. Schroeder, Vander Kolk, & Kist. Illustrating and describing various devices for attachment to members of a bridge or other framed structure, to record the deflections under actual loads. 2000 w. Ann des Ponts et Chaussées—2 Trimestre, 1901. No. 45814 E+F.

**Stringers.**

Experimental Examination of the Stringers of Railway Bridges (Enquète Experimentale sur les Longerons des Ponts). N. C. Kist. A report of tests upon the bridges of the Netherlands State Railways with reference to certain breakages in the longitudinal members supporting the rails. 5000 w, 1 plate. Ann des Ponts et Chaussèes—2 Trimestre, 1901. No. 45815 E+F.

**Swing-Bridge.**

Opening Bridge Over the Flood-Course at Winnington. Illustrated description of a recently constructed bridge operated by electric power. 600 w. Engng—Dec. 27, 1901. No. 45294 A.

**Viaducts.**

Arched Viaduct Over the Seine, Paris. Illustrates the viaduct for joining the Gare St. Lazare to the Champ de Mars and to the Invalides Railway Station. Description and further illustrations to appear later. 2-page plate. 200 w. Engng—Jan. 17, 1902. Serial. 1st part. No. 45775 A.

Concrete Steel Details of French Viaducts. Brief illustrated descriptions of brackets and parapets, as given in *Genie Civil*. 350 w. Eng Rec—Dec. 28, 1901. No. 45226.

The New Kinzua Viaduct (Der Neue Kinzua-Viaduct in Nordamerika). Hr. Frahm. A well illustrated description of the new viaduct, with a short history of the old one. 3500 w. Stahl u Eisen—Jan. 1, 1902. No. 45639 D.

## CANALS, RIVERS AND HARBORS.

**Bank Protection.**

The Serrazanetti System of Protective Works for the Banks of Rivers and Brooks (Das System Serrazanetti zur Herstellung von Schutzbauten an Flüssen und Bächen). An illustrated description of a system using wire netting gabions, which has been successfully employed in Italy. 2500 w. Oesterr Wochenschr f d Oeffent Baudienst—Dec. 14, 1901. No. 45689 B.

**Canal Lift.**

Electric Ship's Lift at Henrichenburg. Illustrated description of a ship's lift in which a large tank 230 ft. long, 28 ft. wide, and 8 ft. deep, having sufficient water-carrying capacity and space to float canal vessels up to 800 tons displacement, is moved up and down from one level to the other. 2500 w. Engr, Lond—Jan. 3, 1902. No. 45437 A.

**Canal Navigation.**

Some Important Phases of Canal Navigation, Illustrated by Recent Experiments in Germany. Elnathan Sweet. A consideration of the experiments of Herr R. Haack, in Germany, and the knowledge they give of the negative velocities produced in canal navigation, and the limited rate of dirigible speed. 2800 w. Pro Am Soc of Civ Engrs—Dec., 1901. No. 45213E.

**Cosel.**

The Harbor of Cosel on the Oder, Silesia (Ueber den Oderhafen bei Cosel). Josef Riedel. An illustrated description of this harbor and docks with statistics of costs and traffic. 1 plate. 1500 w. Oesterr Wochenschr f d Oeffent Baudienst—Dec. 7, 1901. No. 45685 B.

**Dredge.**

Marine Suction Dredge (Drague Marine Porteuse à Succion et à Refoulement). An illustrated description of a sea-going dredging vessel, built by L. Smit and Son, Holland. 1 plate. 1800 w. Génie Civil—Jan. 4, 1902. No. 45662 D.

**Dry Dock.**

A New Dry Dock at Baltimore, Md. Illustrated description of one of the largest dry docks in the United States, capable of docking a vessel of 600 ft. in length and 70 ft. beam, with a draft of 22½ ft. 1300 w. Eng News—Jan. 9, 1902. No. 45371.

**Elbe-Kiel.**

The Proposed Elbe-Kiel Canal (Das Project eines Elbe-Kielcanals). Josef Riedel. A review of the project of Hr. August Sartori for a canal between the port of Kiel, on the Baltic, and the Elbe River, at Lauenburg, with map and profile. 1 plate. 1500 w. Oesterr Wochenschr f d Oeffent Baudienst—Dec. 28, 1901. No. 45695 B.

**Flood Prediction.**

The Prediction of the Height of Water in the Elbe and Moldau Rivers in Bohemia (Die Wasserstandsvoraussagen an der Elbe und Moldau in Böhmen). An account of the work of the Austrian Hydrographic Office in observing river levels and giving warning of floods, with tables and diagrams. 2 plates. 4000 w. Oesterr Wochenschr f d Oeffent Baudienst—Dec. 7, 1901. No. 45688 B.

**Holland.**

The North-Sea Canal, the Ymuiden Locks, and the Port of Amsterdam. Illustrated description of the engineering work that has made the city of Amsterdam a sea-port. 3200 w. Engng—Jan. 10, 1902. Serial. 1st part. No. 45545 A.

*We supply copies of these articles. See page 969.*

**Isthmian Canal.**

A Comparison of the Panama and Nicaragua Canal Routes. A general description, with map and diagram, showing the advantages of one route over the other. Also editorials. 5000 w. Sci Am—Jan. 18, 1902. No. 45516.

The Canal Across the Isthmus. Editorial discussion of the routes. 1600 w. R R Gaz—Jan. 3, 1902. No. 45352.

The Isthmian Canal Commission's Explanation of its Choice of Dimensions for the Isthmian Canal. Ill. 1200 w. Eng Rec—Jan. 18, 1902. No. 45714.

The Isthmian Canal Controversy. Two complete articles on the Panama and Nicaragua routes based upon the reports of the International Commission on Panama and of the Nicaragua Canal Commission, with digest of the report just issued, and many illustrations. 14700 w. Sci Am Sup—Jan. 18, 1902. No. 45519.

The Panama Canal Route. Editorial on the changed conditions due to the recent offer of the French company and the present position of the undertaking. 1200 w. Eng Rec—Jan. 25, 1902. No. 45739.

The Report of the Isthmian Canal Commission. Editorial review of the questions as to whether the canal will pay, the risks due to earthquakes and climate, and dimensions and unit prices. 2500 w. Eng News—Jan. 2, 1902. No. 45347.

**Land Reclamation.**

The St. Francis Levee Districts of Arkansas and Missouri. Harry N. Pharr. An interesting account, with maps, of the important engineering work now in progress for reclaiming the land of this basin. 5000 w. Eng News—Jan. 9, 1902. No. 45367.

**Maritime Works.**

Zeebrugge Harbor Works. M. J. Nyssens Hart and M. L. Van Gansberghe. Read before the Glasgow Congress. Illustrates and describes the breakwater construction at this port on the Belgian Coast. 2400 w. Engng—Jan. 10, 1902. No. 45549 A.

**Nile.**

Irrigation in the Nile Valley (Die Bewässerung im Nillande). From reports of the Austrian consul at Cairo, giving a general account of the subject with mention of the works at Assouan and Assiout. 1000 w. Oesterr Wochenschr f d Oeffent Baudienst—Dec. 7, 1901. No. 45687 B.

**Prague.**

The Raft Harbor at Prague-Smichov (Le Port de Flottage de Prague-Smichov). M. Hromas. Describing the harbor for the timber rafts brought down the Moldau from the forests of Bohemia. 3000 w. Ann des Ponts et Chaussées—2 Trimestre, 1901. No. 45818 E+F.

**Review.**

Harbors and Waterways in 1901. A review of works completed, in progress and proposed. 4300 w. Engr, Lond—Jan. 3, 1902. No. 45434 A.

**River Improvements.**

The Mouth of the Danube. C. H. Kühl. Read before the Glasgow Congress. Describes recent improvements effected in the navigable condition of the Sulina branch and outlet of the Danube. Chart. 4200 w. Engng—Dec. 27, 1901. No. 45296 A.

**River Regulation.**

River Regulating Works (Les Travaux de Régularisation et le Régimè des Rivières). L. L. Vauthier. Discussing especially improvement works for the control of inundations. Paper at the VIII Congress of Navigation. 12000 w. Ann des Ponts et Chaussées—2 Trimestre, 1901. No. 45812 E+F.

**Ship Railway.**

Panama Ship Railway (Panama ou Nicaragua). An article strongly advocating a ship railway at Panama, as proposed by M. Amadée Sébillot, and giving a plan and estimates for one. 5000 w. Revue Technique—Dec. 25, 1901. No. 45671 D.

**Zuider Zee.**

The Closing up and Drainage of the Zuider Zee (Abschliessung und Trockenlegung der Zuidersee). A general account of this proposed undertaking, with estimate of the cost. Map. 1800 w. Oesterr Wochenschr f d Oeffent Baudienst—Nov. 30, 1901. No. 45681 B.

## CONSTRUCTION.

**Building Details.**

Structural Features of the Frick Building, Pittsburg. Illustrates and describes the construction of a twenty-story steel-cage fireproof office building. 3900 w. Eng Rec—Jan. 11, 1902. No. 45478.

**Dams.**

A General Review of the Discussion on Proposed Changes in the New Croton Dam. A letter from Alfred Craven, with illustrations. 3000 w. Eng News—Jan. 9, 1902. No. 45369.

A Rock-Fill Dam with Steel Core Across East Canyon Creek, Utah. W. P. Hardesty. Illustrated description of this work, with comments on country irrigated. 3500 w. Eng News—Jan. 2, 1902. No. 45348.

Chief Engineer Hill's Report on Proposed Changes in the New Croton Dam and Jerome Park Reservoir. Official report of William R. Hill. Ill. Also A Special Report of Changes in the Jerome Park Reservoir, by Edwin F. Smith. 8000 w. Eng News—Jan. 16, 1902. No. 45484.

The Benton Mills Dam, Mariposa Coun-

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ty, Cal. Diagrams, illustrations and description of the method of construction. 1000 w. Min & Sci Pr—Jan. 18, 1902. No. 45583.

The Bohio Dam. George S. Morison. Concerning the dam by which the summit level must be maintained on the route of the Panama Canal, describing the formation of the country and the engineering difficulties, and discussing three methods of taking care of the Chagres floods while the dam is building. Ill. 6500 w. Pro Am Soc of Civ Engrs—Jan., 1902. No. 45748 E.

**Dome.**

The Dome of the Reichstags Building in Berlin (Die Kuppel des Reichstagshauses in Berlin). A discussion between H. Zimmermann and Hr. Zschetzsche about the design of this dome, with diagrams and formulæ. 4000 w. Zeitschr d Oesterr Ing u Arch Ver—Dec. 27, 1901. No. 45699 B.

**Educational Buildings.**

The Centenary Collegiate Institute, Hackettstown, N. J. Gives the first-floor plans of interesting new buildings, with information concerning them. 1200 w. Eng Rec—Dec. 28, 1901. No. 45232.

**Elevator.**

The Weehawken Elevator. Illustrated description of a fireproof grain elevator of 2,000,000 bushels total capacity, being built at Pier 7, Hudson River. 3600 w. Eng Rec—Dec. 28, 1901. No. 45230.

**Foundations.**

The Foundation of the Port Richmond Grain Elevator. Illustrated description of crib and foundation work near Philadelphia. 1000 w. Eng Rec—Jan. 18, 1902. No. 45719.

**Grain Storage.**

See Mechanical Engineering, Miscellany.

**Piles.**

The Supporting Power of Piles. Ernest P. Goodrich. A discussion of the use of the common, tapering, round, wooden pile, driven by the ordinary gravity hammer, and held simply by the contact of the surrounding soil. Ill. 7500 w. Pro Am Soc of Civ Engrs—Dec., 1901. No. 45214 E.

**Retaining Walls.**

The Graphical Determination of Retaining Wall Surfaces (Graphische Ermittelung der Flächen von Stützmauer-Profilen). Karl Lechner. An illustrated description of graphical methods in retaining wall calculations. 2 plates. 800 w. Oesterr Wochenschr f d Oeffent Baudienst—Dec. 28, 1901. No. 45696 B.

**Roads.**

Making Roads by Machinery. Waldon Fawcett. Illustrated description of special apparatus employed in road making, with an account of the government investigations of the Office of Road Inquiry of the Department of Agriculture. 1500 w. Sci Am—Jan. 11, 1901. No. 45381.

The State Roads of Massachusetts. Extract from a paper by Albert S. Merrill in *The Municipality*. Concerning the work of the Highway Commission. 2400 w. Eng Rec—Jan. 11, 1902. No. 45477.

**Steel Construction.**

Notes on Iron and Steel Construction. M. M. Sloan. The first of a series of articles aiming to give reliable and working data upon this subject. 2800 w. Am Archt—Jan. 4, 1902. Serial. 1st part. No. 45353.

The Steel Framing of the General Electric Foundry, Schnectady. Illustrates and describes particulars of the structural details. 1100 w. Eng Rec—Jan. 18, 1902. No. 45718.

**Structural Work.**

Colonial Structural Work. An examination of the present position of affairs in England, in an endeavor to discover why colonial trade is given to foreign countries. 4400 w. Engr, Lond—Dec. 20, 1901. No. 45279 A.

**Tunnels.**

Methods of Work on the East Boston Tunnel Extension of the Boston Subway. Account of the work extracted from the report of Chief Engineer Howard A. Carson. Ill. 4300 w. Eng News—Jan. 23, 1902. No. 45732.

Progress on the East Boston Subway and Tunnel. Illustrated description of the construction work on the branch extension of the Boston subway into East Boston. 2500 w. Ry & Engng Rev—Jan. 11, 1902. No. 45470.

Work on the East Boston Tunnel. From the official progress report of Mr. Howard A. Carson. 2300 w. Eng Rec—Jan. 11, 1902. No. 45475.

Test Borings in the Bed of the East River, New York. An account of the subaqueous boring between Manhattan and Brooklyn on the line of the proposed Rapid Transit tunnel. 1000 w. Eng Rec—Jan. 18, 1902. No. 45713.

The Location and Construction of Railway Tunnels. Extracts from a paper by Mr. Arthur E. Rogers, published by the Inst. of Civ. Engrs. Discusses the materials to be tunneled, estimating, &c., giving examples of several tunnels where unusual conditions were met, and methods used. 4000 w. Eng Rec—Jan. 18, 1902. No. 45717.

The Simplon Tunnel (Traforo del Sempione). A Ferrucci. A discussion of the progress up to the close of 1901, and an account of the irruption of water on the Italian side. 1000 w. Gior d Lav Pubb e delle Str Ferr—Jan. 15, 1902. No. 45808 D.

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**Underpinning.**

Underpinning an Unnnished Steel-Cage Building. Illustrated description of an interesting piece of engineering work. An unfinished building thrown out of plumb by adjacent excavations, is restored to a safe condition and foundations built. 1000 w. Eng Rec—Jan. 25, 1902. No. 45745.

**Warehouse.**

A Brick Warehouse Building at Columbus, Ohio. Describes the construction of a 166 x 62-ft. five-story and basement, slow-burning warehouse, costing about $85,000. 1500 w. Eng Rec—Dec. 28, 1901. No. 45231.

## MATERIALS.

**Cement.**

Action of Sulphate of Lime on Cement (Action du Sulfate de Chaux sur les Ciments). L. Deval. A record of experiments with various cements. 1000 w. Bull Soc d'Encour—Dec., 1901. No. 45679 G.

Slag Cement Manufacture in Alabama. Edwin C. Eckel. Description of two slag cement plants now operating near Birmingham, Ala. 1400 w. Eng News—Jan. 23, 1902. No. 45728.

Some Comparisons of Standard Specifications for Testing Portland Cement. E. Duryee. A comparison of the Russian specifications with the American, German, and French rules. 2200 w. Eng News—Jan. 9, 1902. No. 45366.

The Chemical Analysis of Portland Cement. Richard K. Meade. On the value of chemical analysis, what it shows, &c. 800 w. Min & Sci Pr—Jan. 4, 1902. No. 45377.

The Determination of the Soundness of Portland Cement. Translated report of the Committee of the Soc. of German Portland Cement Mfrs. 600 w. Eng Rec—Jan. 18, 1902. No. 45716.

The History, Manufacture, Testing, and Uses of Portland Cement. H. Howard Humphreys. Reviews the history, describes the principal methods of manufacture and testing, and much information of interest. Also discussion. 17700 w. Builder—Dec. 28, 1901. No. 45265 A.

Uniformity of Analysis in the Portland Cement Industry. Describes the method of analysis formulated by the Committee of the Society of Chemical Industry. 1700 w. Eng Rec—Dec. 28, 1901. No. 45228.

**Concrete.**

The Coefficient of Expansion of Concrete. William D. Pence. Describes the scope and method of investigations made, giving results of tests. General discussion. 12500 w. Jour W Soc of Engrs—Dec., 1901. No. 45308 D.

**Flexure.**

The Computation of the Flexure of Rectangular Plates (Le Calcul des Piéces Rectangulaires Fléchies). A. Mesnager. An application of the elastic theory to plates and thin beams, deducing the fundamental equations. 2500 w. Ann des Ponts et Chaussées—2 Trimestre, 1901. No. 45813 E+F.

**Reinforced Concrete.**

Breaking Test of a Reinforced-Concrete Beam (Epreuve j'usqua la Rupture d'une Poutre en Ciment Armé). N. de Tedesco. An illustrated account of tests of reinforced concrete for an infantry barracks at Gorinchem, Holland. 1200 w. Revue Technique—Dec. 10, 1901. No. 45667 D.

Canal Facing in Reinforced Concrete (Revêtement en Béton de Ciment Armé). MM. Barbet & Hausser. A description of the use of reinforced concrete on the Canal de l'Est, at Epinal, with details of the computations. 3500 w. 1 plate. Ann des Ponts et Chaussées—2 Trimestre, 1901. No. 45818 E+F.

Concrete and Brick Construction with Continuous Interwoven Metallic Cores. H. E. P. Cottrell. Illustrated description of a construction which introduces into concrete and brick structures a series of thin rods or bars, which are carried from foundations to roofs, stating the advantages claimed. Also describes works built on this system. 2800 w. Builder—Jan. 11, 1902. No. 45512 A.

Practical Applications of Reinforced Concrete. Jacques Boyer. Prof. Boyer's second article discusses the materials, methods and industrial applications of concrete-steel construction, with numerous illustrations. 4000 w. Engineering Magazine—Feb., 1902. No. 45821 B.

**Slate.**

The Green Slates of the Lake District. T. Mellard Reade and Philip Holland. A study of these roofing slates of the English Lake District. Describes specimens examined. Ill. 6000 w. Quarry—Jan. 1, 1902. No. 45508 A.

**Timber.**

Protecting Timber from Natural Enemies. George Ethelbert Walsh. On the destruction caused by insects and timber-destroying fungi. 2200 w. Archts & Builds Mag—Jan., 1902. No. 45300 C.

The Behavior of Impregnated Wooden Poles of the Austrian Government Telegraph Department (Uber das Verhalten Imprägnierter Holzsäulen im Gebiete der Staats-Telegraphen-Verwaltung). Robert Nowotny. An account of experience with telegraph and telephone poles treated with various preservatives. 2500 w. Oesterr Wochenschr f d Oeffent Baudienst—Nov. 30, 1901. No. 45683 B.

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## MEASUREMENT.

**Hydrography.**

The Steamer "Hydrographer." Illustrated description of the latest addition to the surveying vessels of the U. S. Coast and Geodetic Survey. 800 w. Marine Engng—Jan., 1902. No. 45251 C.

**Meridian.**

The Location of a Meridian by Polar Elevation (Le Tracé d'une Méridienne par une Hauteur de la Polaire). M. Dehalu. Describing a method adapted for use with the surveyor's theodolite, and suitable for topographical surveying. 2000 w. Rev Univ des Mines—Dec., 1901. No. 45803 H.

**Metric System.**

The Metric Convention and the International Bureau of Weights and Measures (La Convention du Mètre et le Bureau International des Poids et Mesures). C. E. Guillaume. M. Guillaume's fourth paper treats of the last expansion of solids, particularly different nickel-steel alloys. Curves and tables. 3500 w. Bull Soc d'Encour—Dec., 1901. No. 45676 G.

**Surveying.**

Some Devices for Increasing the Accuracy or Rapidity of Surveying Operations. Walter Loring Webb. Illustrates and describes devices designed under the direction of the writer. All have been subjected to practical use. 2400 w. Pro Am Soc of Civ Engrs—Dec., 1901. No. 45215 E.

Surveys for the Manhattan Queens Bridge, New York. An account of the method of conducting the surveys, as described in the chief engineer's report. The bridge passes over Blackwell's Island. 1200 w. Eng Rec—Jan. 25, 1902. No. 45742.

The Mining Meridianoscope (Le Méridianoscope Minier). Ch. Monkowski. Describing a form of solar compass adapted for geological surveying in localities in which the presence of iron ore deposits affect the magnetic needle. 1800 w. 1 plate. Rev Univ des Mines—Dec., 1901. No. 45804 H.

## MUNICIPAL.

**Boulevard.**

The Grant Boulevard, Pittsburg. John Brunner. Describes the construction of a boulevard 15,407 feet long and 60 feet wide, between the business and residence sections of the city. 1300 w. Eng Rec—Jan. 18, 1902. No. 45715.

**Consolidation.**

A Combination Public Service Plant. Illustrates and describes a successful example of consolidation of public water, gas and electricity supply at Franklin, Indiana. 1600 w. Elec Rev, N. Y—Jan. 4, 1902. No. 45401.

**Drainage.**

Drainage of the Cemetery at Saaz, Bohemia (Entwässerung des Friedhofes in Saaz). Friedrich Krivanec. An illustrated description of the work and of the drains and underground conduits. 1 plate. 1200 w. Oesterr Wochenschr f d Oeffent Baudienst—Dec. 21, 1901. No. 45693 B.

The Aramingo Drainage System, Philadelphia. George E. Datesman. States the problem presented and gives and an illustrated description of the work. 3000 w. Eng Rec—Dec. 28, 1901. No. 45227.

**Garbage.**

Garbage Collection, Removal, and Final Disposal at Milwaukee, Wis. Illustrates and describes the new municipal garbage crematory, with notes on the history of garbage disposal at Milwaukee, containing useful lessons. 5000 w. Eng News—Jan. 23, 1902. No. 45729.

**Pavements.**

Bituminous Macadam Pavement. Extracts from a paper by Fred J. Warren, before the Boston Soc. of Civ. Engrs. stating the principles upon which this type of pavement is based; and also a summarized statement of some of the work. 3800 w. Eng Rec—Jan. 25, 1902. No. 45744.

**Septic Tanks.**

Experimental Septic Tanks at Ithaca, N. Y. Facts from a thesis by R. B. Williams, Jr., concerning the principles governing the septic-tank method of sewage disposal. Ill. 2500 w. Eng Rec—Jan. 11, 1902. No. 45476.

**Sewage Disposal.**

The Bayer System of Sewage Disposal (Abwasserreinigung, System Alexander Bayer). Abstract of a paper before the Oesterr. Ing. und Architekten Verein, giving a description of a system for purifying sewage and factory and slaughter house wastes, and utilizing many of the products. 1 plate. 7000 w. Oesterr Wochenschr f d Oeffent Baudienst—Nov. 30, 1901. No. 45682 B.

The Development of Sewage Disposal during the Last Century. Charles Mason. Read before the British Soc. of Engrs. Reviews the various stages through which the theory and practice of sewage purification has passed during the last century. 1800 w. Dom Engng—Jan. 15, 1902. Serial. 1st part. No. 45579 C.

Sewerage and Sewage Disposal of Burton-upon-Trent. Jonah Walker Smith. A paper published by the Inst. of Civ. Engrs. A description of the work that has been carried out since 1883, describing the conditions previous to that time. The sew-

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age is pumped to a farm and treated by broad irrigation and intermittent filtration. 4300 w. Eng Rec—Jan. 25, 1902. No. 45743.

Sewerage of the Passaic River Valley. Editorial discussing the methods of final disposal of the domestic and manufacturing sewage of this district proposed in the recently submitted report of Messrs. Herring, Croes, and Brown. 1500 w. Eng Rec—Dec. 28, 1901. No. 45224.

### WATER SUPPLY.

**England.**

Water Affairs. An editorial review of the principal events of the past year in England. 5000 w. Jour Gas Lgt—Dec. 31, 1901. No. 45417 A.

**Purification.**

The Pittsburg Water Purification Works. Illustrated detailed description of new works to comprise a pumping station and a large slow-sand filtration plant. 4500 w. Eng Rec—Jan. 25, 1902. No. 45740.

**Reservoir.**

The Jerome Park Reservoir. Editorial discussion of the recent developments and reports concerning changes recommended. 1400 w. Eng Rec—Jan. 18, 1902. No. 45711.

**Well Boring.**

Deep Well Boring at the Bavaria Brewery in Altona (Tiefbrunnenbohrung in der Bavaria-Brauerei in Altona). Hr. Darapsky. An account of the difficulties met and overcome in boring 190 metres for water, near the mouth of the Elbe. 1200 w. Zeitschr d Ver Deutscher Ing—Dec. 21, 1902. No. 45602 D.

### MISCELLANY.

**Education.**

The Education of an Engineer. T. Hudson Beare. Delivered before the students of the Univ. of Edinburgh, Glasgow, Scotland. Briefly describes the methods adopted in America, in Germany, and in England; stating also the writer's views. Gives an idea also of the great number being educated in technical colleges, and other information of interest. 5800 w. Naut Gaz—Jan. 16, 1902. No. 45503.

**Hawaiian Islands.**

Some Interesting Engineering Feats. John Ericson. Brief outline of the important works constructed in the Hawaiian Islands since their annexation to the United States. 1000 w. Mod Mach—Jan. 1902. No. 45446.

## ELECTRICAL ENGINEERING

### COMMUNICATION.

**Belgium.**

Telephones in Belgium. Describes the service, and notes the change from equal assessments to the message system. 1000 w. U S Cons Repts, No. 1240—Jan. 16, 1902. No. 45500 D.

**Brazil.**

Telegraph System of Brazil. A report of the telegraph lines, rates, and matters of interest in regard to their operation. 1700 w. U S Cons Repts, No. 1239—Jan. 15, 1902. No. 45409 D.

**Cables.**

Notes on the Cable Industry in Germany. Mervyn O'Gorman. Discusses German practice, concluding that it is not ahead of the English, but that seeds of important advance have been sown. 1100 w. Elec Rev, Lond—Jan. 17, 1902. No. 45766 A.

**Construction.**

Telephone Construction—City Work Plans. W. H. Johnson. This first article discusses present conditions, and the making of plans. 2800 w. Telephony—Dec., 1901. Serial. 1st part. No. 45399.

**Exchanges.**

Glasgow Corporation Telephone Exchange. Detailed illustrated description of a municipal telephone equipment. 3800 w. Elect'n, Lond—Dec. 20, 1901. Serial. 1st part. No. 45255 A.

The Construction of Small Telephone Exchanges. A. E. Dobbs. Discusses the advantages and disadvantages of party lines and gives suggestions for farmers' lines. 1800 w. Elec Rev, N. Y—Jan. 4, 1902. No. 45400.

Ventilation of a Telephone Exchange. Illustrated description of an interesting example of ventilating where the avoidance of drafts was difficult. 1400 w. Eng Rec—Jan. 11, 1902. No. 45479.

**German Empire.**

Telegraphy and Telephony in the German Empire (Telegraphen-und Fernsprechwesen im Deutschen Reichs-Postgebiet). Abstract of the official statistics for 1900. 1500 w. Elektrotech Zeitschr—Dec. 19, 1901. No. 45620 B.

**High-Speed Telegraphy.**

High-Speed Telegraphy (Rundschau). An editorial discussion of the advantages of and need for high-speed telegraphy and

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automatic apparatus, particularly in Germany. 1200 w. Elektrotech Zeitschr—Dec. 19, 1901. No. 45615 B.

**Nomenclature.**

The Origin of Telephonic Nomenclature. Harry S. Coyle. An explanation of the sources from which the terms used are derived. 1800 w. Telephony—Jan., 1902. No. 45591.

**Poles.**

The Passing of Telephone Poles. Thomas F. Gilroy. An illustrated article on the changes in New York city resulting from abolishing aerial wires. 1400 w. Am Tel Jour—Jan. 11, 1902. No. 45443.

See also Civil Engineering, Materials.

**Printing Telegraph.**

Applications and Requirements of a Printing Telegraph. Romyn Hitchcock, in the *Telegraph Age*. Presents reason why such an invention would never take the place of the Morse key in general telegraphic work, and discusses the lines where it would doubtless find use. 2000 w. Ry & Engng Rev—Jan. 11, 1902. No. 45471.

**Relay System.**

Power Plants for Relay Switchboards. A. A. Burch. Discusses the designing of a power plant for a relay system, the power supply, test of plant, care required, &c. 7500 w. Telephony—Feb., 1902. No. 45590.

**Repeating Coils.**

Something About Repeating Coils. A. E. Dobbs. An illustrated article giving information concerning coils used on long telephone lines. 1600 w. Am Tel Jour—Jan. 11, 1902. No. 45442.

**Space Telegraphy.**

Some Experiments with Wireless Telegraphy. Experiments made with the Armorl system are illustrated and described. 2000 w. Sci Am—Jan. 18, 1902. No. 45517.

Some Unconsidered Aspects of Wireless Telegraphy. Charles T. Child. Discusses considerations arising from Mr. Marconi's work and their results, and their practical utilization. 1100 w. Elec Rev, N. Y—Jan. 11, 1902. No. 45458.

The Slaby-Arco Portable Field Equipment for Wireless Telegraphy. A. Frederick Collins. An illustrated article discussing improvements made in this system. 2100 w. Sci Am—Dec. 28, 1901. No. 45221.

Wireless Telegraphy v. Submarine Cables. Discusses Mr. Marconi's recent experiments and his claim of having received a signal across the Atlantic; also its possible effect on the cable system, quoting from many authorities as to the outlook. 2000 w. Elec Rev, Lond—Jan. 17, 1902. Serial. 1st part. No. 45767 A.

**Telephone Cable.**

Measurements of Telephone Cables with Self Induction (Messungen an einem Fernsprechkabel mit Selbstinduktion). Dr. F. Breisig. An account of experiments with telephone conductors wound with iron wire to increase their inductance. 3000 w. Elektrotech Zeitschr—Dec. 19, 1901. No. 45619 B.

The Underground Telephone Network at Chaux-de-Fonds, Switzerland (Das Unterirdische Telephonnetz zu Chaux-de-Fonds). An illustrated description, abstracted from *Journal Telegraphique*, of a telephone distribution system. 1000 w. Elektrotech Zeitschr—Jan. 9, 1902. No. 45633 B.

**Telephony.**

Telephone Engineering. Franz J. Dommerque. The first of a series of articles devoted to the discussion of the building and maintenance of telephone plants and the operation of exchanges. 1400 w. Am Elect'n—Jan., 1902. Serial. 1st part. No. 45332.

The Bell Company's Central Energy System. W. S. Henry. An explanation, with diagrams, of the principles of the Hayes common battery system. 2500 w. Am Elect'n—Jan., 1902. No. 45335.

**Testing.**

Electrical Testing for Telephonists. H. S. Webb. Describes apparatus necessary where much testing is to be done, in addition to the ordinary magneto set. The present article describes galvanometers and shunts. 2500 w. Am Tel Jour—Jan. 25, 1902. Serial. 1st part. No. 45781.

**Toll-Lines.**

Rules and Specifications for the Construction of Telephone Toll Lines and Farmers' Circuits. W. H. Crumb. Ill. 5000 w. Telephony—Dec., 1901. No. 45398.

## DISTRIBUTION.

**Alternating Currents.**

Power Factor in Alternating Current Circuits. Fred W. Ballard. An illustrated article discussing the effect of the power factor on the efficiency, and regulation, and describing a method for plotting the curves of current and electromotive force in alternating current circuits. 2500 w. Engr, U S A—Jan. 1, 1902. Special number. No. 45576 C.

The Induction Motor and the Rotary Converter and Their Relation to the Transmission System. Charles F. Scott. An examination of their behavior in service, indicating the characteristics which have made them so successful. 3500 w. Trans Am Inst of Elec Engrs—Dec., 1901. No. 45488 D.

The Theory and Calculations of Alternating-Current Transmission Lines.

Charles W. Startsman. A discussion aiming to point out the difficulties attending electric power transmission and to show how far they have been overcome. 3500 w. Elec Rev, N. Y—Dec. 28, 1901. No. 45237.

**Booster.**

A Method for Diminishing the Drop of Potential in Rails Carrying the Return Current (Ueber ein Neues Verfahren zur Verminderung des Schienenpotentialgefälles bei Elektrischen Bahnen mit Schienenrückleitung). Gisbert Kapp. A paper before the Elektrotechnische Verein, with diagrams, advocating the installation of booster dynamos at points along the railway, feeding into the rails. With discussion. 5000 w. Elektrotech Zeitschr—Jan. 2, 1902. No. 45630 B.

**Electrical Systems.**

Electrical Systems. John H. Ryan, Jr. An illustrated description of apparatus and working of the various systems. 5400 w. Engr, U S A—Jan. 15, 1902. No. 45598.

**Fault Finding.**

Fault Finding on Long Series Arc Circuits. F. B. O'Hanlon. The article applies more particularly to underground circuits and discusses methods of testing. 1000 w. Am Elect'n—Jan., 1901. No. 45333.

**Lightning Arrester.**

Horn-Shaped Lightning Arresters with Iron Armature (Hörnerblitzableiter mit Eisenarmirung). Eugen Klein. An illustrated description of a modification of the Elihu Thomson lightning arrester, in which iron plates are placed on the horns in order to drive the arc toward the far ends and extinguish it. 800 w. Elektrotech Zeitschr—Dec. 19, 1901. No. 45618 B.

**Polyphase Circuits.**

Elastic Polyphase Circuits (Elastische Drehstromleitungen). Prof. J. Teichmüller. A mathematical investigation of the behavior of polyphase circuits when the different phases are variously loaded, with diagrams. Serial. 2 parts. 6000 w. Elektrotech Zeitschr—Jan. 2, 9, 1902. No. 45626 each B.

**Regulations.**

Regulations for the Installation of Electric Conductors (Instruction Technique pour l'Etablissement des Conducteurs d'Energie Electrique). The proposed French official regulations for all kinds of aerial and underground electric wires. 2000 w. Revue Technique—Dec. 25, 1901. No. 45674 D.

**Three-Phase.**

Three-Phase Distribution for Power and Lighting. Sydney Woodfield. Presents the advantages of this system, and discusses other systems. Also briefly describes potential regulators. 2000 w. Elec Rev, Lond—Jan. 3, 1902. No. 45421 A.

## ELECTRO-CHEMISTRY.

**Cells.**

The Dry Cell. C. F. Burgess. Gives a summary of tests made at the University of Wisconsin, by A. A. Radtke. 1300 w. Elec Wld & Engr—Jan. 25, 1902. No. 45721.

**Chlorates.**

The Corbin Process and Cell for the Electrolytic Production of Chlorates. John B. C. Kershaw. Illustrated description of the process as operated at Chedde, in Savoy. 1000 w. Elec Rev, Lond—Jan. 17, 1902. No. 45764 A.

**Electrolysis.**

The Electrolysis of Fused Salts. Richard Lorenz. Discusses questions raised in an article by C. C. Gerrard, reviewing work of Mr. Lorenz. 1800 w. Elec Chem & Met—Dec., 1901. No. 45527 A.

**Review of 1901.**

The Electro-Chemical and Electro-Metallurgical Industries in 1901. John B. C. Kershaw. The present article reviews the condition of alkalies and bleach, aluminum, calcium carbide, and the chlorate industry. 4000 w. Elect'n, Lond—Jan. 3, 1902. Serial. 1st part. No. 45419 A.

**Waste Tin.**

The Recovery of Pure Tin from Waste Tin Cutttings by Electricity. F. Gelstharp. Describes a new process for the economical recovery by electricity. Ill. 2000 w. Elec Chem & Met—Dec., 1901. No. 45528 A.

## ELECTRO-PHYSICS.

**Diagrams.**

Geometrical Loci in Alternating-Current Diagrams (Geometrische Oerter in Wechselstromdiagrammen). M. Schenkel. A mathematical article showing the advantages of determining loci of quantities found by vector analysis. Diagrams. 1200 w. Elecktrotech Zeitschr—Dec. 19, 1901. No. 45617 B.

**Electrostatic Field.**

A Novel Reaction between Electrostatic Tubes of Force and Insulators (Sur une Nouvelle Réaction entre les Tubes Electrostatiques et les Isolateurs). W. de Nicolaiève. A record of experiments with insulating bodies in an electrolyte conveying a current. 600 w. Comptes Rendus—Dec. 30, 1901. No. 45844 D.

**Geissler Tubes.**

Contribution to the Study of Geissler Tubes in a Magnetic Field (Contribution à l'Etude des Tubes de Geissler dans un Champ Magnetique). H. Pellat. An ex-

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perimental study of electric discharges in vacuum tubes. 800 w. Comptes Rendus—Dec. 23, 1901. No. 45841 D.

**Induction.**

Laws of Electric Energy (Lois de l' Energie Electrique). E. Carvallo. A note criticising Maxwell's laws of electromagnetic induction and offering substitutes, with short account of experiments. 700 w. Comptes Rendus—Dec. 23, 1901. No. 45840 D.

**Kirchhoff's Laws.**

Extension of Kirchhoff's Two Laws (Extension des Deux Lois de Kirchhoff). E. Carvallo. Extension of Kirchhoff's laws of currents in a network to conductors in three dimensions, to variable currents and to dielectrics. 800 w. Comptes Rendus—Dec. 30, 1901. No. 45843 D.

**Magnetic Fields.**

Alternating and Rotating Magnetic Fields. Harold B. Smith. An outline of the methods and laws by which magnetic fields are developed under the application of alternating electromotive forces and resulting currents. 2200 w. Jour Worcester Poly Inst—Jan., 1902. No. 45746 C.

**Magnetization.**

The Determination of the Magnetization Constants (Die Bestimmung der Konstanten in der Magnetisirungsfunction). E. Müllendorff. A mathematical discussion of formulæ expressing the relation between the magnetizing force H and the magnetic induction B, and their agreement with Kapp's experimental curves. Tables. 2400 w. Elektrotech Zeitschr—Jan. 9, 1902. No. 45631 B.

**Oscillators.**

An Experimental Investigation into the "Skin"-effect in Electrical Oscillators. C. A. Chant. An account of investigations made in the Jefferson Physical Laboratory, Harvard University. Ill. 5300 w. Am Jour of Sci—Jan., 1902. No. 45304 D.

**Physiological Effect.**

The Action of High Frequency Currents upon Animals (Action des Courants de Hautes Fréquence (Application Directe) sur les Animaux). H. Bordier et Lecompte, with remarks by M. d'Arsonval. A description of experiments proving that these currents penetrate into the bodies of animals, when electrodes are directly applied. 1200 w. Comptes Rendus—Dec. 30, 1901. No. 45845 D.

**Radiography.**

On the Existence of Rays which Undergo Reflection in the Radiation Emitted by a Mixture of Chlorides of Radium and of Barium (Sur l'Existence de Rayons qui Subissent la Réflexion dans le Rayonnement Emis par un Mélange de Chlorures de Radium et de Baryum). Th. Tommasina. A record of experiments proving the existence of such rays. 500 w. Comptes Rendus—Dec. 30, 1901. No. 45846 D.

Stereoscopic Röntgen Ray Pictures. Frank C. Perkins. Reviews some of the stereoscopic methods of locating foreign substances buried in the tissues of the body. Ill. 1400 w. Elec Wld & Engr—Jan. 18. 1902. No. 45710.

## GENERATING STATIONS.

**Capacity Limits.**

Capacity Limits of Direct Current Dynamos and Motors. Alton D. Adams. States the limits that fix the safe capacity, discovering the distinctive features in their application. 2500 w. Engr, U S A—Jan. 1, 1902. Special no. No. 45577 C.

**Dynamo Design.**

The Calculation of the Fall of Potential in Alternating Current Generators (Berechnung des Spannungsabfalles von Wechselstromgeneratoren). J. Fischer-Hinnen. A discussion of the mathematical design of alternators and polyphase generators, particularly Prof. Potier's method, with tables and diagrams. 3000 w. Elektrotech Zeitschr—Dec. 26, 1901. No. 45622 B.

**Edison Station.**

The New Power Station of the New York Edison Company. Gives a brief description of the plants now in use and an illustrated description of the Waterside station, situated on the East River, between 38th and 39th sts. 5400 w. Eng Rec—Jan. 4, 1902. No. 45341.

The New Water Side Station of the New York Edison Co. Illustrated description of this station which furnishes current for lighting and power purposes. 6600 w. Power—Jan., 1902. No. 45472.

The Waterside Station of the New York Edison Company. The first of a series of fully-illustrated articles describing this large station, its equipment and operation. 4500 w. Elec Wld & Engr—Jan. 4, 1902. Serial. 1st part. No. 45396.

**Electric Supply.**

The Stretford Regulations as to the Supply of Electrical Energy. A copy of the regulations drafted by C. H. Wordingham. 3500 w. Elec Engr, Lond—Jan. 17, 1902. No. 45758 A.

**Gas Driving.**

A Gas Engine Driven Electric Power Plant at Saltley, England. Illustrated description of an electric power installation being placed in works for the manufacture of railway carriages and wagons of all types, street cars and all kinds of vehicles for heavy and light railways. 2000 w. Engr, U S A—Jan. 15, 1902. No. 45596.

**Glasgow.**

The Pinkston Power Station of the

Glasgow Corporation Electric Tramways. Arthur H. Allen. Illustrated description of what is undoubtedly the finest station yet built in the United Kingdom. 9000 w. Engr, U S A—Jan. 1, 1902. Special number. No. 45572 C.

**High Potential.**

The Control of High Potential Systems of Large Power. E. W. Rice, Jr. Briefly outlines the principles which the writer believes should govern in the layout of stations of normally large output, giving illustrated description of devices for controlling and switching used in the Metropolitan and Manhattan stations of New York city. 3900 w. Trans Am Inst of Elec Engrs—Dec., 1901. No. 45489 D.

**Hydro-Electric Plant.**

Shawenegan Falls Power Plant. Illustrates and describes features of an important installation in Canada. 1500 w. Sci Am—Jan. 18, 1902. No. 45518.

The Red Bridge Power Station of the Ludlow Manufacturing Company. Illustrated detailed description of recently built works at Ludlow, Mass., for developing about 5000 horse-power. 2700 w. Eng Rec—Dec. 28, 1901. No. 45225.

**Isolated Plants.**

An Interesting Residence Plant. Illustrates and describes the principal features of the equipment recently installed in a house at Newport, R. I. 500 w. Am Elect'n—Jan., 1902. No. 45330.

Dividing the Power in Isolated Plants. H. F. Schmidt. Describes a method by which a heavy and light load can be taken care of at the smallest first cost, and yet be operated at very good efficiency. Ill. 500 w. Am Elect'n—Jan., 1902. No. 45331.

Electrical Equipment of a Southern Newspaper Plant. Louis Elliott. Illustrates and describes the isolated plant of the "Dallas-Galveston News." 1700 w. Am Elect'n—Jan., 1902. No. 45328.

Electric Light and Power Installation at the Lancashire County Asylum, Rainhill. Particulars and illustrations of an interesting and carefully designed installation. 1400 w. Elec Engr, Lond—Jan. 17, 1902. No. 45756 A.

The Application of the Storage Battery to Isolated Plants. S. E. Rucker. Discusses systems carrying loads in club houses and buildings of a like nature, also those plants which operate during the day and have need of only a small portion of the capacity after 7 p. m., and methods of computing battery equipments. Ill. 4000 w. Am Elect'n—Jan., 1902. No. 45327.

The Economy of Isolated Electric Plants. Isaac D. Parsons. Mr. Parsons' second paper reviews, in a very accurate manner, the usually inaccessible field of power plants installed in residential buildings, with valuable results. 4500 w. Engineering Magazine—Feb., 1902. No. 45825 B.

The Electric Equipment of a Large Hospital. Charles E. Knox. Illustrated detailed description of the lighting and power plant of the Lying-in Hospital, New York. 3500 w. Am Elect'n—Jan., 1902. No. 45326.

**Lighting Station.**

Central-Station Lighting. J. A. Seager. Thinks the stations should not only be well lighted, but should display the newest and most effective arrangements as an object lesson. Also discusses the proper source and distribution of station lighting, and other related matters. 2000 w. Elec Engr, Lond—Jan. 17, 1902. No. 45757 A.

Maidstone Electricity Works. Illustrated description of recently opened electric-lighting works. 2000 w. Elec Engr, Lond—Jan. 3, 1902. No. 45420 A.

**Load Factors.**

Electricity Works Load Factors. J. Gray Scott. Read before the Glasgow Technical College Scientific Society. Explains the peculiar conditions which control the generation and distribution of electricity for the purposes to which it is applied, the effect on the cost, and the means whereby the conditions may probably be made more favorable. 5400 w. Elec Engr, Lond—Dec. 20, 1901. No. 45258 A.

Load Factors and Circuit Breakers. Arguments showing the close connection between the load factor and circuit breaker and the need of judgment in estimating the limit of economy. 1800 w. Elec Rev, Lond—Dec. 27, 1901. No. 45267 A.

**Manhattan Elevated.**

Opening the Power Station of the Manhattan Elevated Railway. Illustrated description of the powerful stationary engines for driving the alternators for the New York Elevated railways. The total horse-power of the station will be 100,000. Also editorial. 2200 w. Sci Am—Jan. 11, 1902. No. 45380.

See also Railways and Tramways, Motive Power and Equipment.

**Power Development.**

Quebec Railway, Light and Power Co., Montmorency Falls. An illustrated description of this installation, it being one of the first developments under a high head in America. 2100 w. Can Engr—Jan., 1902. No. 45453.

**Reconstruction.**

Reconstructing or Modernizing Central Stations. O. M. Rau. Presents a plan for reconstructing many small stations which are operating with old inefficient apparatus. The installing of alternating current machinery. 1800 w. Elec Rev, N. Y—Jan. 25, 1902. No. 45724.

*We supply copies of these articles. See page 969.*

**Rheydt-Gladbach.**

The Rheydt-Gladbach Electric Installation (Das Electricitätswerk Rheydt-Gladbach). H. Leisse. An illustrated description of the electric station at Rheydt and the electric railway between that town and Gladbach, in Rhenish-Prussia. 2000 w. Elektrotech Zeitschr—Jan. 2, 1901. No. 45627 B.

**San Francisco.**

Plant of the Independent Electric Light and Power Company, San Francisco. Illustrated detailed description of a recently built plant. 1600 w. Elec Wld & Engr—Jan. 4, 1902. No. 45397.

The Independent Electric Light and Power Company. Illustrated description of a San Francisco plant representative of the latest and best American ideas of modern steam station practice. 6000 w. Jour of Elec—Dec., 1901. No. 45499.

**Sparking.**

Sparking Produced by Defective Commutators, and the Remedy. William Baxter, Jr. Discusses the requirements in order that commutator brushes may run without sparking and gives suggestions for correcting defects. Ill. 2000 w. Marine Engng—Jan., 1902. No. 45254 C.

Sparkless Commutation with Fixed Brushes. Claude W. Hill. Reviews the method of calculation which gave satisfactory results with the older forms of machine having copper brushes, and indicates the modification necessary to obtain satisfactory working with fixed carbon brushes and minimum gap excitation, by which means a minimum weight of machine may be obtained. 2500 w. Elec Rev, Lond—Jan. 10, 1902. No. 45543 A.

**Supply Works.**

The Crystal Palace District Electricity Supply Works. A detailed description of the station as it is since the recent alterations. Ill. 1700 w. Elect'n, Lond—Jan. 10, 1902. No. 45541 A.

**Syracuse, N. Y.**

The Central Station of the Syracuse Lighting Company. An illustrated description of an interesting well constructed station of medium size. 1200 w. Elec Rev. N. Y—Jan. 25, 1902. No. 45723.

**Transformers.**

Paralleling of Alternate-Current Transformers. Arnold G. Hansard. The object of the paper is to explain the principles in a simple way for those who do not care to study the subject mathematically. 1300 w. Elec Times—Jan. 16, 1902. No. 45755 A.

**Winding.**

Winding Field Coils from Flat Copper Strips. Illustrates and describes a machine which winds copper ribbons edgewise into coils for the fields of electrical machines. 3000 w. Ir Age—Jan. 2, 1902. No. 45242.

## LIGHTING.

**Chicago.**

The Lighting System of the Chicago Edison Company. An illustrated study of the plant and methods of one of the largest electric lighting supply companies in the world. 4400 w. Elec Rev, N. Y—Jan. 11, 1902. No. 45456.

**Incandescent Lamps.**

A Study of the Variations in Luminous Intensity of Alternating-Current Incandescent Lamps during One Complete Alternation (Etude des Variations d'Intensité Lumineuse dans une Période, des Lampes à Incandescence Alimentées par Courants Alternatifs). C. Leonard and P. Janet. A description of experiments and results, with tables and curves. 4000 w. Bull Soc Internationale de Electriciens—Dec., 1901. No. 45835 E.

The Danger of Fire in the Use of Incandescent Lamps for Decoration (Feuersgefahr bei Verwendung von Glühlampen zur Dekoration). C. Ankersen. An account of experiments with incandescent lamps covered with wadding, which charred or burned and caused the lamps to break. 600 w. Elektrotech Zeitschr—Jan. 9, 1902. No. 45634 B.

The Incandescent Lamp of To-day. John W. Howell. A few facts relating to these lamps and the features that have made them popular. 700 w. Trans Am Inst of Elec Engrs—Dec., 1901. No. 45491 D.

**Lighting Stations.**

See Generating Stations.

**Nautical Spectacles.**

Method of Lighting the Great Water Tank at the Nouveau Cirque, Paris. Illustrated description. 1000 w. Sci Am—Dec. 28, 1901. No. 45223.

**Nernst Lamp.**

The Nernst Lamp. Illustrates and describes this lamp as commercially developed. 1100 w. Sci Am—Jan. 11, 1902. No. 45382.

**Photometry.**

The Present Status of the Question of a Standard of Light. Clayton H. Sharp. Discusses progress toward a satisfactory standard. At present photometrists are limited to a choice of either a pentane standard or the Hefner lamp as primary standards. 1000 w. Trans Am Inst of Elec Engrs—Dec., 1901. No. 45493 D.

**Street Illumination.**

Street Illumination and Units of Light. W. D'A. Ryan. An account of photometric comparisons made of open and enclosed arcs, giving curves. 2000 w. Trans Am Inst of Elec Engrs—Dec., 1901. No. 45490 D.

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**Vapor Lamps.**

Electric Gas Lamps and Gas Electrical Resistance Phenomena. Peter Cooper Hewitt. Describes some of the phenomena exhibited by mercury gas lamps and some of the difficulties encountered in determining the relative values of the resistances therein. 2500 w. Trans Am Inst of Elec Engrs—Dec., 1901. No. 45494 D.

## MEASUREMENT.

**Armature Resistance.**

Measurement of the Armature Resistance of Continuous Current Machines (Messung des Ankerwiderstandes von Gleichstrommaschinen). A. Wettler. A. description, with diagrams and formulæ, of a method of measuring the resistance of various forms of armature windings. 800 w. Elektrotech Zeitschr—Jan. 2, 1902. No. 45628 B.

**Cable Testing.**

Methods of Eliminating Corrections for the Leads, etc., in Cable Testing. H. Savage. Begins an explanation of methods. Ill. 1200 w. Elec Rev, Lond—Jan. 17, 1902. Serial. 1st part. No. 45765 A.

**Dynamometer.**

The Electromagnetic Absorption Dynamometer. C. Arthur Conant and Clifton R. Hayes. Describes this novel piece of apparatus showing its good qualities and its faults. Ill. 3000 w. Jour Worcester Poly Inst—Jan., 1902. No. 45747 C.

**Fault Localization.**

The Localization of Faults in Submarine Cables (Eingrenzung von Fehlern in Seekabeln). A description of methods, with diagrams. 2400 w. Elektrotech Zeitschr—Jan. 2, 1902. No. 45629 B.

**Induction Motors.**

Complete Commercial Test of Polyphase Induction Motors Using One Wattmeter and One Voltmeter. A. S. McAllister. An interesting article offering suggestions tending toward the elimination of all unnecessary apparatus. Shows what may be computed from the use of a single wattmeter in connection with a polyphase induction motor, supplied from constant potential mains. 1800 w. Elec Wld & Engr—Jan. 11, 1902. No. 45468.

**Meters.**

Discussion at Buffalo, August 21st, of Papers by Lincoln, Haskins, Davis and Browne. Discussion of papers on meters and metering of electrical energy. 12400 w. Trans Am Inst of Elec Engrs—Dec., 1901. No. 45487 D.

The Influence of Terrestrial Magnetism on Instruments of Precision (Ueber den Einfluss des Erdmagnetischen Feldes auf Präcisionsinstrumente). Konrad Windmüller. An illustrated account of experiments which show the influence of the earth's magnetic field upon the readings of Weston voltmeters. 400 w. Elektrotech Zeitschr—Dec. 26, 1901. No. 45625 B.

**Motor Testing.**

The Testing and Management of Electric Motors. P. T. White. A discussion of methods of testing is commenced in the present article. 1400 w. Elec Rev, Lond—Dec. 27, 1901. Serial. 1st part. No. 45266 A.

**Stray Currents.**

Measurements of Stray Currents in Gas and Water Pipes (Messungen von Vagabundirenden Strömen in Gas und Wasserrohren). Absalon Larsen and S. A. Faber. An account of systematic investigations conducted in Copenhagen, with description of methods and maps, diagrams and tables. 3500 w. Elektrotech Zeitschr—Dec. 19, 1901. No. 45616 B.

**Stress.**

Thermo-Electric Measurement of Stress. C. A. P. Turner. A description of methods used, giving results obtained under somewhat unfavorable circumstances, with remarks regarding the errors, and the data that might be obtained by further investigations. 11300 w. Pro Am Soc of Civ Engrs—Jan., 1902. No. 45749 E.

**Telephone Cable.**

See Electrical Engineering, Communication.

## POWER APPLICATIONS.

**Asynchronous Motors.**

Tests of a Compensated Asynchronous Motor (Die Ersten Versuchsresultate am Kompensirten Asynchronmotor). Alexander Heyland. An illustrated description of tests of an asynchronous alternating current motor, with compensation windings. 1500 w. Elektrotech Zeitschr—Jan. 9, 1902. No. 45632 B.

The Asynchronous Motor Run as a Synchronous One (Der Asynchronmotor als Synchronmotor). Ernst Danielson. An illustrated description of a method for running a non-synchronous motor synchronously by sending continuous current through the secondary winding. 700 w. Elektrotech Zeitschr—Dec. 26, 1901. No. 45623 B.

**Cotton Mills.**

Electricity in Southern Cotton Mills. George E. Walsh. Concerning the application of electricity as a source of power. 2000 w. Elec Rev, N. Y.—Jan. 4, 1902. No. 45402.

**Furnace Power.**

The Dynamo as an Adjunct to the Blast Furnace. Horace Allen. Describes applications of the electric current that may be made with advantage. 1000 w. Elec Rev, Lond—Jan. 3, 1902. No. 45424 A.

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**Haulage.**

Electric Mine Haulage. W. B. Clarke. Explains the influence of grades, curves, track construction, etc., upon the capacity of locomotive required for a given work. 2700 w. Mines & Min—Jan., 1902. No. 45386 C.

**Induction Motors.**

Some Pointers on Induction Motors. Dr. Louis Bell. Discusses the objections often raised, and the wrong ideas prevalent, and gives information concerning their usefulness. 1500 w. Elec Wld & Engr—Jan. 18, 1902. No. 45709.

**Machine Driving.**

Electrically Driven Machine Tools. A. L. De Leeuw. Discussion of general principles, with illustrations showing application of motors. 4800 w. Mach, N. Y.—Jan., 1902. No. 45405.

**Pumping.**

A Mine-Pumping Plant with Electrically-Driven Centrifugal Pumps. Illustrated description of the plant installed in the silver mine of Horcajo, in Spain, stating the conditions to be met. 2000 w. Eng News—Jan. 23, 1902. No. 45730.

Electrically Driven Pumping Machinery (Elektrisch Betriebene Wasserhaltungen). Hr. Hansen. A paper giving an account of various electric pumping plants for mine drainage and particularly of the Riedler express pump, with discussion. 1500 w. Zeitschr d Ver Deutschr Ing—Jan. 4, 1902. No. 45610 D.

Electric Feed Pumps. A. Johnston. Discusses methods of regulating the amount of water. 1500 w. Elec Rev, Lond—Jan. 10, 1902. No. 45542 A.

**Reversing Switch.**

Automatic Protective Device for Reversing Switches with Continuous Current Motors (Selbstschutzvorrichtungen für Gleichstrommotoren an Wendeanlassern). Rudolph Krause. An illustrated description of starting and reversing apparatus by which sparking and excessive currents are prevented. 600 w. Elektrotech Zeitschr—Dec. 26, 1901. No. 45624 B.

**Shipbuilding.**

Electric Appliances in Shipbuilding Yards. Sydney F. Walker. A fully illustrated paper showing the advantages of electric power in shipyards for power distribution and for the operation of heavy tools. 3000 w. Engineering Magazine—Feb., 1902. No. 45822 B.

## TRANSMISSION.

**New Zealand.**

An Electric Power Transmission Plant in New England. Oswald Haes. Abstract of a paper read before the Elec Assn of N. S. W. Description of the system and plant. 2500 w. Elect'n, Lond—Dec. 27, 1901. No. 45284 A.

**Supply.**

The Supply of Electrical Power Over Large Areas. F. J. Warden Stevens. Considers the question from a point of view of the public, the local authorities and the companies. 2000 w. Archt, Lond—Jan. 3, 1901. No. 45413 A.

## MISCELLANY.

**Carbon.**

The Manufacture of Carbon for Electrical Purposes (Note sur la Fabrication des Charbons Agglomérés pour l'Electricité). J. Worms. A review of the manufacture of compressed carbons for arc lamps, batteries, microphones and other electrical purposes. 1400 w. Electricien—Dec. 14, 1901. No. 45854 B.

**Electrical Progress.**

Electrical Progress and Legislation: The Need of Revision. R. Percy Sellon. An address before the London Chamber of Commerce. Sketches the condition of the electrical industries in England and the causes that have placed the country in serious arrear of the position she should have attained. 3200 w. Elec Rev, Lond—Dec. 27, 1901. Serial. 1st part. No. 45268 A.

**Electricity Tariffs.**

Some Principles Underlying the Profitable Sale of Electricity. Arthur Wright. A defence of the maximum demand system, with suggestions for its modification. 4800 w. Elect'n, Lond—Dec. 20, 1901. Serial. 1st part. No. 45256 A.

**Electric Supply.**

Principles and Profits in Electrical Supply. W. B. Esson. A discussion of electricity tariffs, called out by paper of Mr. Arthur Wright. Considers the maximum demand system erroneous and sketches a proposed method of charging. 3300 w. Elec'n, Lond—Jan. 3, 1902. No. 45418 A.

**Pan-American.**

Electricity at the Pan-American Exposition (L'Electricité à l'Exposition de Buffalo). Georges Dary. A general review. 2800 w. Electricien—Nov. 9, 1901. No. 45849 B.

**Review.**

Electrical Progress in 1901. A review of the advances made during the year showing that it was a year of unusual progress. 2500 w. Elec Rev, N. Y.—Jan. 11, 1901. No. 45455.

**Safety Rules.**

Report on the New Safety Regulations of the Verband Deutscher Elektrotechniker (Bericht über die Neuen Sicherheitsvorschriften des Verbandes Deutscher Elektrotechniker). Dr. C. L. Weber. A review and discussion, at a meeting of the Elektrotechnische Verein, of the German electrical safety regulations. 2000 w. Elektrotech Zeitschr—Dec. 19, 1901. No. 45621 B.

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# GAS WORKS ENGINEERING

**Acetylene.**

Acetylene Lighting in Mines (Ueber Versuche mit Acetylen-Beleuchtung in Bergwerken). Abstracted from the *Zeitschrift für das Berg Hütten und Salinenwesen.* An account of trials of acetylene safety lamps and other lamps in German mines. 3000 w. Glückauf—Jan. 4, 1902. No. 45650 B.

A Note on an Acetylene-in-Oxygen Flame. Clayton H. Sharp. Brief account of experimental investigations on a flame produced by the combustion of a mixture of equal parts of acetylene and hydrogen in an atmosphere of oxygen. 800 w. Trans Am Inst of Elec Engrs—Dec., 1901. No. 45492 D.

The Third International Acetylene Congress at Paris in 1900 (Der III. Internationale Acetylen Congress in Paris 1900). Heinrich Koechlin. A general account of the organization of the congress and abstract of the proceedings. 3500 w. Oesterr Wochenschr f d Oeffent Baudienst—Dec. 21, 1901. No. 45694 B.

**Burner.**

The Welsbach Gasoline Burner. Illustrated description of a lamp of high efficiency. 600 w. Sci Am—Jan. 25, 1902. No. 45702.

**Coke-Oven Gas.**

Coke Oven Gas for Lighting, Heating and Power (Ueber die Verwendung von Koksofengas zu Leucht Wärme und Kraftzwecken und die Verbesserung desselben durck Benzolcarburation). Hugo Kutscher. An account of the manufacture and use of coke oven gas and its enrichment by benzol, with a description of the plant at Everett, Mass. 3000 w. Glückauf—Dec. 28, 1901. No. 45647 B.

**Combustion.**

Combustion in Gas Producers and Benches. Robert W. Prosser. Facts on the working of gas producers showing the effects of various methods and the advantages and disadvantages of each. 3600 w. Am Gas Lgt Jour—Jan. 20, 1902. Serial. 1st part. No. 45581.

**Distribution.**

Gas Distribution at Leeds. Illustrated description of a system of extension and enlargement of mains. 1700 w. Gas Wld —Jan. 18, 1902. No. 45761 A.

**Exhibition.**

Gas at the Crystal Palace. An account of the exhibits shown at the International Gas Exhibition. Considers it a meagre representation of the industry and not fitly named. Ill. 5500 w. Gas Wld—Dec. 21, 1901. No. 45261 A.

**High Pressure.**

Thermal Emissivity in High-Pressure Gases. Discusses researches of Mr. J. E. Petavel which are of high interest to the engineer. An important contribution to thermo-dynamics. 3800 w. Engng—Jan. 3, 1902. No. 45427 A.

**Incandescent Lighting.**

Intensive Incandescent Lighting. M. Greyson de Schodt. Summary of a lecture to the Dutch Gas Assn. Explains the theory of incandescent lighting and gives an illustrated description of recent improvements made by the writer. 1500 w. Gas Wld—Dec. 21, 1901. No. 45262 A.

**Liquor Distillation.**

The Use of Lime in Liquor Distillation. E. Blum. The substance of a paper read before the Mid-Rhenish Assn of Gas & Water Engrs. Illustrates and describes the method and apparatus for preparing concentrated ammoniacal liquor. 1700 w. Jour of Gas Lgt—Jan. 7, 1902. No. 45-524 A.

**Mixtures.**

Explosive Gas Mixtures. Dr. H. Bunte. Abstract translation of a paper read before the German Assn of Gas & Water Engrs. Gives tabulated results of explosion investigations and explains the behavior of gases under various conditions. 2800 w. Jour Gas Lgt—Dec. 24, 1901. Serial, 1st part. No. 45263 A.

**Modern Practice.**

Modern Practice in the Manufacture and Distribution of Gas. Harry Edward Jones. Extracts from a paper read before the Inst. of Civ. Engrs. of London, Eng. Considers the influence of Welsbach light, the coin meter, and sliding scale legislation, labor-saving machines, residuals, etc. 5000 w. Pro Age—Jan 15, 1902. Serial. 1st part. No. 45504.

**Natural Gas.**

Natural Gas in 1900. F. H. Oliphant. Information from the Mineral Resources of the United States for 1900. 2500 w. Pro Age—Jan 15, 1902. No. 45505.

**Oil Gas.**

Gas from Oil. Process as conducted on the Pacific coast. Facts relative to the producing gas oils in the state of California, an ' the methods of using them. Ill. 1500 w. Am Gas Lgt Jour—Jan. 13, 1902. No. 45466.

**Paris.**

The Gas Question in Paris (Le Nouveau Régime du Gaz à Paris). A review of the report of M. Lauriol, chief engineer for lighting in Paris, on plans for the im-

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provement and increase of the gas supply, by private companies or the city itself. 2800 w. Génie Civil—Dec. 21, 1901. No. 45659 D.

The Gas Question in Paris. Particulars from a report by M. Lauriol, studying a scheme for new works and discussing the cost of manufacture, and other matters of interest. 2500 w. Jour Gas Lgt—Jan. 7, 1902. No. 45523 A.

**Water Gas.**

Carburetted Water Gas in Europe. J. T. Westcott. An account of the development. 1600 w. Am Gas Lgt Jour—Jan. 27, 1902. No. 45725.

# INDUSTRIAL ECONOMICS

## INDUSTRIAL ECONOMICS.

**Consolidation.**

Consolidated Labor. Carroll D. Wright. An analysis of the attitude of the public and of law toward labor unions, and the attitude of labor unions toward industrial society. 6400 w. N Am Rev—Jan., 1902. No. 45302 D.

**Corporate Developments.**

Mr. James J. Hill on Consolidations, Competition and Rates. Address on the relations of railways to the public interests, delivered at Fargo, N. D., before the Grain and Stock Growers' Convention. 2800 w. Ry Age—Jan 17, 1902. No. 45558.

**Education.**

American Educational Wisdom. Stuart Uttley. A comparison of the general attitude of the people in England and America toward technical education. 3500 w. Ir Age—Jan. 30, 1892. No. 45786.

The Education of Mechanical Engineers and Chemists in the Higher Mechanical Schools of Russia. M. Sserebroffsky and G. von Doepp. An account of the schools at present devoted to this work, their regulations, courses of study, etc. 3000 w. Sib Jour of Engng—Jan., 1902. No. 45751 C.

**Employes.**

Pension and Insurance System Adopted in Providence. Describes a scheme for providing employes with pensions, sick benefits, and insurance. 1500 w. St Ry Rev—Jan 15, 1902. No. 45566 C.

**Factory Act.**

The Factory Act, 1901. Discusses the new matter in the act that came into force on Jan. 1, 1902, in Great Britain. 2200 w. Engr, Lond—Dec. 27, 1901. No. 45289 A.

**Foreign Commerce.**

A Neglected Factor in Our Commercial Expansion. Albert Halstead. On the value of American consular service and the reports published. 3300 w. N Am Rev—Jan., 1902. No. 45301 D.

**Health.**

The Hygiene of Workers in Mines. Dr. E. W. King. Discusses some of the causes that tend to impair the health and shorten the lives of those employed in this vocation. 5000 w. W Min Wld—Jan. 11, 1902. No. 45502.

**Inventory.**

See Mechanical Engineering Machine Works and Foundries.

**Iron Trade.**

The Chicago Iron Trade in 1901. George W. Cope. A review of the year which is reported as more active than any previous year. Discusses the conditions, the strike, consolidations, trade, prices. etc. 4800 w. Ir Age—Jan. 2, 1902. No. 45243.

The Eastern Iron Markets. Thomas Hobson. A review of the year, considering pig iron, billets, exports, finished material, old material, etc. 3300 w. Ir Age—Jan. 2, 1902. No. 45246.

The Pittsburg Iron Trade in 1901. Robert A. Walker. A review discussing the general features, consolidations, foreign trade, new construction, labor troubles, prices, the outlook, etc. 1200 w. Ir Age—Jan. 2, 1902. No. 45245.

**Labor.**

Australian Labor Laws and Their Bearing on Trade Unionism. Stafford Ransome. Discusses the new law in Australia and its effect, but does not assume that even if it works well there, it would apply to Great Britain or other countries. 2000 w. Engr, Lond—Jan. 3, 1902. No. 45441 A.

Labor Unions and Labor Contracts. D. L. Cease. Discusses the benefits expected from the labor contracts, and the improved attitude of workmen. 1700 w. Gunton's Mag—Jan., 1902. No. 45359 C.

**Patent Office.**

The Patent-Office Library. Illustrates the new patent-office, Southampton Buildings, describing the new library recently opened. 1500 w. Engr, Lond—Jan. 10, 1901. No. 45554 A.

**Premium System.**

Premium Plan of Rewarding Labor. H. M. Norris. Stenographer's report of paper read before the Engine Builders' Assn. An explanation of the system as introduced at the works of The Bickford Drill & Tool Co., Cincinnati, Ohio. 4800 w. Engr, U S A—Jan. 1, 1902. Special number. No. 45578 C.

The Premium Plan at the Works of David Rowan and Company, Glasgow, Scotland. James Rowan. Also "The

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Origin of the Premium Plan." A Personal Statement by F. A. Halsey. Descriptive article. 3700 w. Am Mach—Jan. 9, 1902. No. 45454.

**Prizes.**

Prizes Awarded by the French Academy for 1901 (Prix Décernés Année 1901). A list of prizes and sketches of the recipients. Also prizes offered for 1902, 1903, 1904, 1905 and 1906. 20000 w. Comptes Rendus—Dec. 16, 1901. No. 45839 D.

**Review.**

1901. A review of the year's history in Great Britain in mechanical and electrical engineering, gas supply, war material and chemistry. 20500 w. Engr, Lond—Jan. 3, 1902. No. 45438 A.

Sanitary Engineering and Water Supply in 1901. Reviews the results of the year in sewage disposal, water supply, and related matters. 4000 w. Engr, Lond—Jan. 3, 1902. No. 45436 A.

**Sault Ste. Marie.**

Engineering and Industrial Enterprises at Sault Ste. Marie. An illustrated general description of the various industrial enterprises centered here. 8000 w. Eng News—Jan 9, 1902. No. 45365.

**Subsidy.**

Ship Subsidy Bill. A copy of the bill introduced in the U. S. Senate by Mr. Frye. 2200 w. Marine Engng—Jan., 1902. No. 45253 C.

**Workmen's Dwellings.**

Austro-Hungarian Legislation for Encouraging the Erection of Sanitary and Cheap Workmen's Dwellings (Regierungsvorlage betreffend Begünstigungen für Gebäude mit Gesunden und Billigen Arbeiterwohnungen). A review of proposed legislation giving privileges to buildings of the class named, relieving them from taxes, etc. 3000 w. Oesterr Wochenschr f d Oeffent Baudienst—Dec. 7, 1901. No. 45684 B.

**Works Management.**

Money-Making Management for Workshop and Factory. C. U. Carpenter. The first of an important series of papers. This instalment deals with the executive, working and recording departments. 4000 w. Engineering Magazine—Feb., 1902. No. 45823 B.

Problems in the Management of a Railway Shop. R. T. Shea. Gives illustrations of chances for saving in some of the larger shops. 1300 w. Loc Engng—Jan., 1902. No. 45316 C.

Shop Administration. W. W. McLaren. Stenographer's report of paper read before Engine Builders' Assn. States the conditions and discusses questions bearing upon development and operation. 2700 w. Engr, U S A—Jan. 1, 1902. Special number. No. 45574 C.

The Commercial Management of Engineering Works. G. Siebert. Discussing the relation of mercantile and engineering talent, and showing how the combination of both is essential to attain commercial success. 2500 w. Engineering Magazine—Feb., 1902. No. 45820 B.

## MARINE AND NAVAL ENGINEERING

**Battleship.**

The Japanese Battleship Mikasa. Illustration, with plan and section, and full description of what is said to be "the finest battleship in the world." 2200 w. Engr, Lond—Jan. 10, 1902. No. 45551 A.

The Launch of the Battleship "Missouri." Illustrated description of this vessel, the last of the three of the "Maine" class, launched Dec. 28, 1901. 1200 w. Sci Am—Jan. 11, 1902. No. 45379.

**Car Ferries.**

Car Ferry (Les Car-Ferries). An account of ice-breaking ferryboats on the American Great Lakes. 1200 w. Revue Technique—Dec. 25, 1901. No. 45672 D.

**Cargo Boats.**

Developments in Cargo-Boat Machinery. Benjamin Taylor. Traces developments of the marine engine during the last quarter of the last century. 3800 w. Marine Rev—Dec. 26, 1901. No. 45212.

**Coal-Carrying.**

Ocean Transportation for Coal. Information concerning the transportation of coal from Great Britain and America to France. 1600 w. U S Cons Repts, No. 1234—Jan. 9, 1902. No. 45297 D.

**Cobra Disaster.**

The Loss of the British Torpedo Boat Destroyer "Cobra" (La Perte du Contre-Torpilleur Anglais "Cobra"). S. Gradier. A description of this steam-turbine vessel and her loss with a review of the court of inquiry proceedings. 2000 w. Génie Civil—Dec. 28, 1901. No. 45661 D.

**Cruiser.**

German Cruiser König Wilhelm Ersatz. Illustrated description of interesting changes which place this vessel in advance of the Prinz Heinrich. Tabulated data of recent cruiser designs are given. 1500 w. Engr, Lond—Dec. 27, 1901. No. 45292 A.

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**Fire Boats.**

New and Powerful Steel Fire Boat. Illustrates and describes a new boat to be built for the city of Milwaukee. 2200 w. Marine Rev—Jan. 16, 1902. No. 45582.

Twin-Screw Fire Float for Durban Harbor. Illustrations, with brief description, of a boat recently built for the Natal Government. 400 w. Engng—Jan. 10, 1902. No. 45547 A.

**Harbor Boats.**

Harbor Lighterage and Transportation. H. L. Joyce. A study of the system in New York Harbor, its growth, difference in style of craft from time to time, and the many changes in methods and in class of traffic. Also discussion. 10500 w. N Y R R Club—Dec. 19, 1901. No. 45449.

**Hydrography.**

See Civil Engineering, Measurement.

**Icebreakers.**

Ice Breaking in Germany (Eisbrechwesen in Deutschland). Hr. Boost. A historical sketch of methods of breaking up ice in rivers with explosives, and a review of modern ice-breaking boats for rivers and harbors. 700 w. Zeitschr d Ver Deutscher Ing—Dec. 21, 1901. No. 45601 D.

**"Kronprinz Wilhelm."**

The New German Liner "Kronprinz Wilhelm" (Der Neue Deutsche Schnelldampfer "Kronprinz Wilhelm"). An illustrated general account of this great North German Lloyd Steamship. 1000 w. Glasers Ann—Jan. 1, 1902. No. 45614 D.

**Merchant Marine.**

The Transformation of the Merchant Marine (Transformation du Materiél de la Marine Marchande). Mr. Vetillart. Report presented to the VIII International Congress of Navigation. An important paper. 15000 w. Ann des Ponts et Chaussées—2 Trimestre, 1901. No. 45810 E+F.

**"Neckar."**

The Imperial-Mail Steamship "Neckar" (Der Reichspostdampfer "Neckar"). A fully illustrated description of this North German Lloyd 18,700 ton steamship, and of its boilers, engines and fittings. 2 plates. 2500 w. Zeitschr d Ver Deutscher Ing—Jan. 4, 1902. No. 45605 D.

**Non-Sinkable.**

The Non-Sinkability of Large Steel Ships (L'Insubmersibilité des Grands Navires d'Acier). M. E. Duchesne. Advocating the use of double hulls, as well as water-tight bulkheads for the prevention of disasters at sea. 3500 w. Mem Soc Ing Civ de France—Nov., 1901. No. 45819 G.

**Resistance.**

The Hydraulics of the Resistance of Ships. Edgar C. Thrupp. Read before the Glasgow Congress. An investigation of the discovery that there is an enormous divergence from the laws of stream line motion when the dimensions of the channels or pipes are such as to have hydraulic radii exceeding 1 in. or 2 ins. 3300 w. Engng—Dec. 20, 1901. No. 45275 A.

**Shipbuilding.**

Present Tendencies of Lake Ship Building. Waldon Fawcett. Comments on the return to normal size, instead of building the large vessels introduced at the close of the last century. Also notes other tendencies in the most recent vessels. Ill. 1700 w. Am Mfr—Jan. 23, 1902. No. 45586.

Shipbuilding and Marine Engineering in 1901. A review of the ship tonnage constructed in the works of the United Kingdom. 3700 w. Engng—Jan. 3, 1902. Serial. 1st part. No. 45432 A.

Shipbuilding and Marine Engineering During 1901. A review of the year; the present article dealing with the volume of work and its broad general features, as well as with the measure of activity in the several districts of the United Kingdom. 3500 w. Engr, Lond—Jan. 10, 1902. Serial. 1st part. No. 45550 A.

The Development of American Shipbuilding in the Last Decade (Die Entwickelung des Amerikanischen Schiffbaues im Letzten Jahrzehnt). Prof. Oswald Flamm. Abstract of a paper by Tjard Schwarz before the "Schiffbautechnische Gesellschaft" on shipbuilding, and cranes and other shipyard appliances in the United States. Ill. 1200 w. Stahl u Eisen—Jan. 1, 1902. No. 45640 D.

See also Electrical Engineering, Power Applications.

**Ship Railway.**

See Civil Engineering—Canals, Rivers and Harbors.

**Shipyards.**

Japanese Shipyards. Editorial on the progress Japan is making towards the supply of her own fleet. 2500 w. Engng—Jan. 3. 1902. No. 45431 A.

Notes on the Equipment of Foreign shipyards. C. C. Thomas. Describes the appliances used in British shipyards, comparing them with the American yards. 3000 w. Marine Engng—Jan., 1902. No 45248 C.

**Stability.**

A Stability Diagram. George Crouse Cook. A practical method of calculating and plotting a series of curves of the centers of buoyancy, from which the curve of statical stability may be deduced for any variations in displacement or loading. 1200 w. Naut Gaz—Jan. 2, 1902. No. 45404.

**Steamship Design.**

Design of Ocean Steamers. Theodore Lucas. Discussion of the designing of

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ships for particular uses, giving diagrams. 2000 w. Naut Gaz—Jan. 2, 1902. No. 45-403.

**Steamships.**

New Ships of the Boston Steamship Company. Illustrates and describes two 11,000 ton freight steamships now under construction. 1100 w. Marine Engng—Jan., 1902. No. 45247 C.

**Subsidy.**

See Industrial Economics.

**Tank Experiments.**

Experiments upon the Propulsion of Models of Ships (Esperienze di Propulsione con Modelli di Navi). Nino Pecoraro. A discussion of experiments in the testing tank at the Arsenal at Spezia, with especial reference to the use of electrically operated propellers on the models. 6000 w. 2 plates. Rivista Marittima—Dec., 1901. No. 45800 E+F.

**Testing Tank.**

The Equipment of the Canal of the Hydraulic Laboratory of Cornell University for Experimental Work on the Resistance and Propulsion of Ships. Dr. William F. Durand. Describes this canal and the equipment thus far installed. Ill. 2000 w. Sib Jour of Engng—Jan., 1902. No. 45-752 C.

**Turbine Steamer.**

Turbine Steamer King Edward. W. Cartile Wallace. An illustrated article giving information concerning this boat and the general impression her arrangements made on the writer. 3000 w. Marine Engng—Jan., 1902. No. 45249 C.

**Warships.**

Progress of Warships and Machinery Building in England. A résumé of the progress made in naval construction during the last six months. 1700 w. Engr, Lond—Dec. 27, 1901. No. 45290 A.

Warship building in 1901. A review of the additions during the year to the British Navy. 2500 w. Engng—Dec. 20, 1901. Serial. 1st part. No. 45276 A.

# MECHANICAL ENGINEERING

## AUTOMOBILES.

**Alcohol Fuel.**

Alcohol and Automobiles. From *The Motor World*. Discusses the recent tests of this fluid in the neighborhood of Paris. 1400 w. Sci Am Sup—Jan. 25, 1902. No. 45708.

Alcohol Automobiles at the Paris Alcohol Exhibition. The present article gives an illustrated description of the Gobron-Brillié system. 800 w. Sci Am—Dec. 28, 1901. Serial. 1st part. No. 45222.

**Alcohol Motors.**

See Mechanical Engineering, Special Motors.

**Automobile Show.**

Résumé of the New York Automobile Show. Alex. Schwalbach. An illustrated article pointing out the most striking characteristics. 4000 w. Auto Mag—Jan., 1902. No. 45210 C.

**Classification.**

The Rational Classification of Motor Vehicles. Albert L. Clough. Considers the only logical method of classification to be on the basis of the ratio of the actual maximum horse power capable of being continuously delivered by the motor to the total weight carried. 1200 w. Horseless Age—Jan. 1, 1902. No. 45338.

**Comparison.**

The Vehicles of To-day and Yesterday. C. C. Bramwell. A comparison of the vehicles which took part in the first automobile run from New York, with those which participated in the Endurance Run. 1200 w. Horseless Age—Dec. 25, 1901. No. 45235.

**France.**

The Automobile in France To-day. Hart O. Berg. Abstract of a lecture, delivered at the Automobile Club of America. 4300 w. Auto Mag—Jan., 1902. No. 45211 C.

**Ignition.**

Ignition. Ernest J. Hutton. Extracts from a paper that is to form a part of a book on motor driving, soon to be issued. 4500 w. Autocar—Jan. 11, 1902. No. 45509 A.

**Internal Combustion.**

Generation and Distribution of Hot Gases in Internal Combustion Engines. Charles E. Lucke. Discusses points in hot gas generation and some of the principles to be considered in designing these engines. 2500 w. Horseless Age—Jan. 15, 1902. Serial. 1st part. No. 45521.

**Lubrication.**

Positive and Cleanly Lubrication. Albert L. Clough. Explains forced feed lubrication and its advantages. 900 w. Horseless Age—Jan 8, 1902. No. 45373.

**Motor Car.**

An Interesting Car Built by an Amateur. An account of the experiences of C. H. Johnson, of Leeds, Eng., in amateur motor car construction. Ill. 1700 w. Autocar—Jan. 18, 1902. Serial. 1st part. No. 45760 A.

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**Motor Vehicles.**

The Business Vehicle Problem. Robert G. Pilkington. Discusses the general form of delivery wagons, and the applications. 2000 w. Horseless Age—Jan. 1, 1902. No. 45337.

**Paris Exhibition.**

The Paris Automobile Exhibition. Illustrates and describes some of the more important exhibits at what proved to be a most successful exhibition, the profits reaching about $20,000. 5500 w. Auto Jour—Jan., 1902. No. 45769 A.

The Paris Autocar Show. An illustrated description of some of the leading novelties exhibited. 13600 w. Autocar—Dec. 21, 1901. No. 45260 A.

The Paris Motor Car Show. An account of this annual exhibition of motor vehicles, the exhibits, and the changes noted. Ill. 2500 w. Engr, Lond—Jan. 3, 1902. Serial. 1st part. No. 45435 A.

**Road Lessons.**

The Troubles and Pleasures of an Inexperienced Beginner With a Gasoline Automobile. Harry B. Haines. A report of experiences while learning to manage the machine. 2800 w. Horseless Age—Jan. 22, 1902. No. 45589.

**Single Cylinder.**

The Packard Single Cylinder Motor Wagon. Hugh Dolnar. A full illustrated description of the mechanical details of this new vehicle. 4300 w. Autocar—Dec. 28, 1901. No. 45285 A.

**Sparking.**

Spark Control. Albert L. Clough. A discussion of spark regulation on automobile engines. 1000 w. Horseless Age—Jan. 22, 1902. No. 45587.

**Speed Gear.**

The Howard Speed Change Gear. Illustrated description of a new speed gear of the planetary type. 1100 w. Horseless Age—Jan. 15, 1902. No. 45523.

**Standardization.**

The Standardization of Controlling Mechanisms. Albert L. Clough. Urges the general adoption of that method which offers the most advantages. 1200 w. Horseless Age—Jan. 8, 1902. No. 45374.

**Steam Engines.**

Patterns and Core Boxes for the Hyler White Steam Engine. W. O. Anthony. Illustrates and describes the construction. 4000 w. Horseless Age—Jan. 22, 1902. No. 45588.

The Superheated Steam Engine. Henri G. Chatain. Describes these engines and discusses their advantages for road locomotion. 1700 w. Horseless Age—Jan. 15, 1902. No. 45520.

**Steam Vehicles.**

The "Locomobile" Steam Carriage. Illustrated detailed description. 2000 w. Sci Am Sup—Jan. 25, 1902. No. 45707.

The Steam Motor Car. An illustrated article explaining the mechanism of one of the latest cars. 2500 w. Engr, Lond—Dec. 20, 1901. No. 45280 A.

**Trucks.**

Merchandise Transport by Automobile Trucks (Transport par Cannons Automobiles). M. Bret. An examination of the various types of motor trucks with regard to their availability for service in the streets of Paris. 10000 w. Ann des Ponts et Chaussées—2 Trimestre, 1901. No. 45811 E+F.

**Tyres.**

Hints on the Use and Care of Tyres. H. Wilton Bartlett. Discusses tyre diameters, wheel sizes, oil, nipping patches, etc. 2500 w. Autocar—Jan. 18, 1902. No. 45759 A.

**War Office Trials.**

The War Office Heavy Motor Vehicle Trials. Full illustrated description of the mechanical features of the lurries, with observations on their performance. 7000 w. Auto Jour—Jan., 1902. No. 45768 A.

## HYDRAULICS.

**Canal Power.**

How Chicago Will Harness the Drainage Canal. Edward P. Ellicott. Explains how the construction of this canal has created an opportunity for developing a great water power, discussing the advantages to be derived. 1500 w. Mod Mach—Jan., 1902. No. 45445.

**Flow.**

A Proposed Solution of Some Hydraulic Problems. Discussion of the paper by Charles H. Tutton. 2500 w: Pro Am Soc of Civ Engrs—Dec., 1901. No. 45220 E.

A Proposed Solution of Some Hydraulic Problems. Continued discussion of a paper by Charles H. Tutton. 1700 w. Pro Am Soc Civ Engrs—Jan., 1902. No. 45750 E.

Current Meter and Weir Discharge Comparisons. Continued discussion of paper by Edward C. Murphy. 600 w. Pro Am Soc of Civ Engrs—Dec., 1901. No. 45218 E.

Experiments at Detroit, Mich., on the Effect of Curvature Upon the Flow of Water in Pipes. Continued discussion of paper by Gardner S. Williams, Clarence W. Hubbell and George H. Fenkell, Jr. 5000 w. Pro Am Soc of Civ Engrs—Dec., 1901. No. 45216 E.

**Ice Troubles.**

Freeing the Niagara Canal Races from

Ice. Arthur B. Weeks. Illustrates and describes the methods and appliances used. 450 w. Am Elect'n—Jan., 1902. No. 45-334.

**Plumbing.**

Plumbing in the Tombs Prison, New York. Illustrates and describes the hot and cold water supply and drainage system of the new part of the Tombs prison. 2200 w. Eng Rec—Jan. 4, 1902. No. 45-344.

**Pumping Plant.**

Centrifugal Pumping Plant for Wallasey Dock. Illustrated description of one of the largest plants of its kind erected and working in Great Britain. 800 w. Engr, Lond—Jan. 10, 1902. No. 45553 A.

**Pumps.**

Ventilators and Centrifugal Pumps for High Pressures Driven by Steam Turbines or Electric Motors (Ventilateurs et Pompes Centrifuges pour Hautes Pressions, Mus pas Turbines à Vapeur ou par Moteurs Electriques). M. Rateau. An elaborate and well illustrated record of investigations showing the superiority of the steam turbine for driving high pressure ventilating fans and centrifugal pumps. 11000 w. Bull Soc d'Encour—Dec., 1901. No. 45677 G.

**Pumping Machinery.**

See also Electrical Engineering, Power Applications.

**Turbines.**

On a Leaf Arrester for the Water Supply of a Turbine. Earl of Rosse. Illustrates and describes an apparatus that has worked successfully in directing the leaves to a side channel and into the tail-race. 700 w. Engng—Jan. 10, 1902. No. 45-548 A.

The Development of the Turbine (Die Entwickelung der Turbine). Prof. R. Escher. A historical sketch of turbines and their regulating apparatus. 2 parts. 6000 w. Schweiz Bauzeitung—Dec. 21, 28, 1901. No. 45837 each B.

## MACHINE WORKS AND FOUNDRIES.

**Boiler Plates.**

Table for Finding the Thickness of Boiler Plates. George F. Summers. Table with brief explanation of its use. 400 w. Am Mach—Jan. 16, 1902. No. 45533.

**Case Hardening.**

Case Hardening for Fine Grain. E. R. Markham. Explains how machine steel may be hardened so as to produce a fine grain. 1500 w. Am Mach—Jan. 2, 1902. No. 45394.

Case Hardening Wrought Iron and Machine Steel. E. R. Markham. Gives directions for the work. 2000 w. Am Mach—Jan. 23, 1902. No. 45594.

Points to be Observed in Case Hardening. E. R. Markham. Discusses some points concerning the composition and peculiarities of the stock and materials used. 800 w. Am Mach—Jan. 16, 1902. No. 45531.

**Castings.**

Casting Bases for Upright Boilers. R. H. Palmer. Illustrated description. 500 w. Am Mach—Jan. 2, 1902. No. 45392.

Molding a Sawmill Bed. R. H. Palmer. Illustrated description. 1000 w. Am Mach—Jan. 16, 1902. No. 45534.

**Cast-Iron Pipes.**

English and French Practice in the Manufacture of Cast-Iron Pipes. I. English Practice. Stephen H. Terry. II. French Practice. A. G. Cloake. Two papers read before the British Assn. of Water-Works Engrs. 3700 w. Ir & Coal Trds Rev—Dec. 20, 1901. No. 45271 A.

**Drawing Room.**

Drawing Room; Chief Engineer's Office; Pittsburg & Lake Erie R. R., Pittsburg, Pa. R. P. Forsberg. Illustrated description of the room, tables, card index system, drawings, filing cases, blue print room, etc. 3200 w. Eng News—Jan. 2, 1902. No. 45345.

**Engine Building.**

Modern Engine Building. Notes taken at the shops of the Westinghouse Machine Company. Ill. 3000 w. Mach, N. Y.—Jan., 1902. No. 45406.

**Fly-Wheels.**

Building a Fly Wheel. An illustrated description of methods employed. 1800 w. Power—Jan., 1902. No. 45473.

The Design and Construction of Fly Wheels for Slow Speed Engines for Electrical Lighting and Traction Purposes. A. Marshal Downie. Read before the Inst. of Engrs. & Shipbuilders in Scotland. Discusses the design and application of fly-wheels to large slow speed engines. Ill. 2000 w. Engrs' Gaz—Jan., 1902. Serial. 1st part. No. 45414 A.

**Foundry.**

A Steel Frame Foundry Building. Illustrated description of a fire-proof structure at Harrison, N. J. 1800 w. Eng Rec—Jan. 4. 1902. No. 45342.

New Steel Foundry of the Pennsylvania Steel Company. An illustrated description of a recently completed foundry at Steelton, Penn. It is operated by electricity and all details are strictly up-to-date. 1500 w. Ir Age—Jan. 30, 1902. No. 45-783.

**Gear Cutting.**

The Bilgram Automatic Bevel Gear Generating Machine. Illustrated description of the machine and its operation.

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1400 w. Am Mach—Jan. 23, 1902. No. 45593.

**Gear Teeth.**

Wear of Gear Teeth. Robert A. Bruce. Compares the relative wear of different portions of the profile and the relative amounts of wear which may be expected under assumed conditions to take place in teeth with each of the standard profiles. Ill. 2200 w. Prac Engr—Jan. 3, 1902. No. 45416 A.

**Grinding.**

Safety Appliances for Grinding Machines (Protection des Meules Artificielles). Henry Mamy. A well illustrated account of various ventilating and other safety appliances for the protection of persons running grinding machines. 1 plate. 4000 w. Génie Civil—Dec. 21, 1901. No. 45658 D.

**Guns.**

Repairing Worn-Out Guns on Service. R. Bannatine-Allason. Short illustrated description of a somewhat novel operation of re-lining a damaged 12-pounder 6 cwt. gun. 1000 w. Engr, Lond—Jan. 10, 1902. No. 45556 A.

**Inventory.**

Aids in Taking the Machine-Shop Inventory. Hugo Diemer. Discussing a simple method of employing the card index and showing its advantages for inventory purposes. 2500 w. Engineering Magazine—Feb., 1902. No. 45827 B.

**Leakages.**

Some Leakages in Factory Practice. Walter J. May. Calls attention to points that have been noticed by the writer. 2700 w. Prac Engr—Dec. 27, 1901. No. 45287 A.

**Light Shapes.**

Modern Plants for the Manufacture of Hoops and Merchant Bars. Theodore J. Vollkommer. Illustrates and describes plants where automatic machinery has been introduced, and improved methods. 5300 w. Ir Age—Jan. 16, 1902. No. 45460.

**Lubricating Oils.**

Friction of Lubricating Oils. R. H. Thurston. Discusses some of the results obtained, and the deductions drawn. 1200 w. Am Mach—Jan. 23, 1902. No. 45592.

**Machine Driving.**

See Electrical Engineering. Power Applications.

**Machine Methods.**

Modern Machine Methods. H. F. L. Orcutt. Deals with machine operations, where accuracy and cheapness is secured, as contrasted with laborious and expensive hand work or machines without modern improvements. A suggestive paper to those considering economical methods of manufacture. Ill. 10300 w. Inst of Mech Engrs—Jan., 1902. No. 45754 D.

**Machine Tools.**

A Universal Portable Machine Tool. Illustrated descriptions of devices for drilling, boring and mining, and of the methods of using them. 900 w. Engng—Jan. 17, 1902. No. 45774 A.

Recent Machine Tools (Neuere Werkzeugmaschinen). Prof. F. Bock. A well illustrated description of machine tools manufactured by Sattler, Berner & Co., of Nuremberg, Germany. Serial. Part I. 800 w. Zeitschr d Ver Deutscher Ing—Jan. 4, 1902. No. 45608 D.

**New Works.**

Stanley Works, Newark-on-Trent. Illustrated detailed description. 4500 w. Engr, Lond—Dec. 20, 1901. No. 45282 A.

**Piecework.**

Piecework: Its Evils and Remedies. Gilbert Fox. Discusses this system and its working. 2200 w. Prac Engr—Jan. 10, 1902. No. 45510 A.

**Planers.**

Some Early Planer Inventions. H. O. Coombs. Illustrates and describes interesting machines of machine tool designs in England. 700 w. Am Mach—Jan. 2, 1902. No. 45395.

**Shop Methods.**

Some Jobbing Shop Methods. Joseph V. Woodworth. Illustrates and describes cutting a coarse pitch screw, making thin threaded brass rings, a stepping jig for drilling small holes, etc. 3500 w. Am Mach—Jan. 2, 1902. No. 45393.

**Shop Work.**

The Limit Gauge System of Shop Work. W. H. Booth. Read before the Glasgow Scientific Society. An illustrated article explaining the system and its application. 2500 w. Prac Engr—Dec. 27, 1901. Serial. 1st part. No. 45286 A.

**Taper Tubes.**

Fixture for Forming Taper Tubes with Feed Motion for the Blanks. Moses G. Wilder. Illustrated description of a fixture where the blanks are fed across the front of the press from left to right, and capable of forming 100 to 150 tubes per minute. 1100 w. Am Mach—Jan. 16, 1902. No. 45532.

**Tools.**

Fixtures and Tools for Making Speed Indicators. Joseph Vincent Woodworth. Illustrated description. 800 w. Mach, N. Y.—Jan., 1902. No. 45408.

Machine Shop Tools for Engine Builders. George T. Reiss. Presented at meeting of Engine Builders' Assn. An illus-

trated description of appliances of special character that are useful for special purposes. 3500 w. Engr, U S A—Jan. 15, 1902. No. 45599.

The Tool Chest. A series of descriptive articles presenting the most approved modern hand tools and devices used by mechanics for purposes of drawing, measurement, adjustment, and getting accurate work. Ill. 900 w. Mod Mach—Jan., 1902. No. 45448.

Turret Tools. Illustrated description of tools used for machinery gear blanks in the turret lathe. 1100 w. Mach, N Y—Jan., 1902. No. 45407.

**Turning Machine.**

A New Crank Pin Turning Machine. Illustrated description of a machine where the work remains stationary and the tool travels around it. 1000 w. Ir Age—Jan. 16, 1902. No. 45459.

**Works Management.**

See Industrial Economics.

## MATERIALS OF CONSTRUCTION.

**Alloys.**

Alloys of Copper and Tin. William Campbell. Read before the Inst. of Mech. Engrs. An appendix to the reports of the Alloys Research Committee. Research made to explain the complete freezing point curve of the copper-tin alloys, and to note the change of structure due to casting. Ill. 4700 w. Engng—Jan. 3, 1902. Serial. 1st part. No. 45433 A.

Notes on Alloys of Copper and Iron. J. E. Stead. Read before the Glasgow Congress. A report of research prosecuted during the last year, describing methods and giving results; also showing the influence of carbon in these alloys. Ill. 6000 w. Engng—Dec. 20, 1901. 45277 A.

Upon the Constitution of Binary Alloys. John Alexander Mathews. Gives a résumé of the knowledge gained by the researches of metallurgists, and outlines the present knowledge concerning the nature and constitution of binary alloys. Ill. 5300 w. Jour Fr Inst—Jan., 1902. Serial. 1st part. No. 45372 D.

**Budapest Congress.**

The Budapest Meeting of the International Association for the Testing of Materials (Vom Internationalen Materialprüfungs Congress in Budapest). Prof. H. Wedding. A paper, with discussion, before the "Eisenhütte Oberschlesien," giving an account of the Budapest Congress, the proposed international laboratory at Zürich, etc. 2800 w. Stahl u Eisen—Jan. 1, 1902. No. 45637 D.

The Third Congress of the International Association for the Testing of Materials (Der III. Congress des Internationalen Verbandes für die Materialprüfungen der Technik). K. Haberkalt and A. Stradal. A report of the meeting at Budapest and abstract of the proceedings. 9000 w. Oesterr Wochenschr f d Oeffent Baudienst—Dec. 21, 1901. No. 45692 B.

**Gun Tests.**

The Gathmann Gun Tests. Grahame H. Powell. Some explanatory notes concerning the recent test at Sandy Hook, showing the effect of outside explosion. Ill. 1300 w. Am Mach—Jan. 16, 1902. No. 45530.

**Leather.**

A Chemical Study of Leather (Etude Chimique du Cuir). Ed Nihoul. An exhaustive study of the operations of tanning leather, with especial reference to its uses in the mechanic arts. Serial. Part I. 7500 w. Rev Univ des Mines—Dec., 1901. No. 45802 H.

**Magnalium.**

Alloys of Aluminum and Magnesium (Les Alliages d'Aluminium et de Magnesium). O. Boudouard. A well illustrated account of investigation of these alloys with various proportions of the metals, giving melting points, microscopic examination, etc. 2000 w. Bull Soc d' Encour—Dec., 1901. No. 45678 G.

**Steel.**

How Should Steel for Girders be Tested? Considers how the material should be tested to ascertain whether it is in accordance with the requirements of the specification. 2200 w. Engr, Lond—Jan. 10, 1902. No. 45552 A.

## POWER AND TRANSMISSION.

**Compressed Air.**

Central Compressed Aid Power Plants. From *Granite*. Reviews briefly the conditions that have made these plants necessary, describing a typical installation. 2800 w. Compressed Air—Jan., 1902. No. 45501.

Compressed Air Haulage Plants. Richard Hirsch. An illustrated general description of a plant and its operation, with discussion. 6800 w. Pro Engrs Soc of W Penn—Dec., 1901. No. 45298 D.

## SPECIAL MOTORS.

**Acetylene Motors.**

Acetylene for Gas Engines. Reviews investigations made with this gas as a motive power, and also what has actually been done in everyday work. 3000 w. Engr, Lond—Jan. 17, 1902. No. 45777 A.

**Alcohol Motors.**

Alcohol in Industry (L'Alcool per le Industrie). The report of the commission of the Italian Government upon the proposed methods of using methylated and carburetted alcohol for heating and motive

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power. 2500 w. L'Industria—Jan. 5, 1902. No. 45806 D.

Alcohol Motors in Germany (Les Locomobiles à Alcool en Allemagne). Lucien Périssé. A review of an article in *Vie Scientifique*, giving an account of applications of alcohol motors in agricultural and other work. 800 w. Revue Technique—Dec. 10, 1901. No. 45669 D.

French Spirit Motors. An account of the steps being taken in France and Germany to use alcohol for driving motors, and for lighting and heating purposes. Discusses also the construction of spirit motors. 2500 w. Engng—Jan. 10, 1902. No. 45546 A.

**Ether Motor.**

An Ether-Vapor Generator. From *La Nature*. Gives an account of the early attempts to apply this liquid for the production of motive power and gives an illustrated description of the seeming solution in the invention of Desvignes de Malapert. 2000 w. Sci Am—Jan. 4, 1902. No. 45357.

The "Latent Heat" Fallacy. R. H. Thurston. Discusses the false ideas advanced in relation to the new ether vapor engines. 2000 w. Sci Am Sup—Jan. 25, 1902. No. 45705.

**Gas Engines.**

High Power Gas Engines: Conditions Necessary for Their Successful Working. A. Rollason. Read before the Glasgow and West of Scotland Technical College Scientific Society. Reports, in the present article, tests made of two types of engines to determine their respective capabilities, giving indicator cards. 1300 w. Prac Engr—Jan. 10, 1902. No. 45511 A.

The Gasoline Power Engine. E. W. Roberts. Gives a simple rule for calculating the power of gas engines. 800 w. Min & Sci Pr—Dec. 28, 1901. No. 45351.

What to Do When the Gas Engine Stops. Albert Stritmatter. Discusses the proper method to pursue to locate a trouble when the cause is unknown. 2000 w. Am Mfr—Jan. 9, 1902. No. 45444.

**Ignition.**

The Wydts Electro-Catalytic Sparking Plug. Illustrated description of a device for exploding the charges of gas in a gas or gasoline engine, without the use of electricity or heat; also editorial. 2500 w. Sci Am—Jan. 18, 1902. No. 45515.

**Internal Combustion.**

The Internal Combustion Engine. An illustrated elementary explanation of its working. 2500 w. Autocar—Dec. 21, 1901. No. 45259 A.

**Wave Motor.**

The Santa Cruz Wave Motor. H. W. H. Penniman. Brief description with illustration. 450 w. Sci Am—Jan. 4, 1902. No. 45356.

## STEAM ENGINEERING.

**Boilers.**

Design, Construction and Operation of the Steam Boiler. W. H. Wakeman. Discusses problems concerning the theoretical and practical strength, durability, installation, care and operation of boilers now in actual service. 1700 w. Ill. Mod Mach—Jan., 1902. Serial. 1st part. No. 45447.

Troubles with Boilers. W. F. Durand. Considers some of the more frequent derangements and the measure available for their prevention or repair. 3400 w. Engr, U S A—Jan. 1, 1902. Special number. No. 45573 C.

**Boiler Explosion.**

Report on a Boiler Explosion (Bericht über eine Dampfkessel Explosion). An account of a boiler explosion at Essen, Germany, and the probable causes thereof. 1 plate. 900 w. Glückauf—Nov. 23, 1901. No. 45641 B.

**Chimneys.**

Chimneys. George A. Orrok. How to determine height and calculate draft; methods of construction are discussed. 2000 w. Power—Jan., 1902. No. 45474.

The Horse Power of a Chimney. W. H. Wakeman. Considers only natural draft, and explains how to calculate the horse power. 1500 w. Elec, N Y—Jan. 15, 1902. No. 45498.

**Comparative Practice.**

English, American, and Continental Steam Engineering. Philip Dawson. Mr. Dawson's concluding paper is devoted to American engines and traction power houses, with numerous illustrations. 4000 w. Engineering Magazine—Feb., 1902. No. 45824 B.

**Cylinder Clearance.**

Effect of Cylinder Clearance upon Steam Economy. Ira C. Hubbell. Illustrates graphically and demonstrates the important relation between cylinder clearance and steam consumption. 4300 w. St. Louis Ry Club—Dec. 31, 1901. No. 45299.

**Feed Pump.**

Boiler Feed Pump Operation in Isolated Plants. J. N. Cravath. A discussion of methods. 1000 w. Am Elect'n—Jan., 1902. No. 45336.

**Feed Water.**

Feed Water for Boilers. G. James Wells. Abstract of a paper read before the Manchester Soc. of the Inst. of Elec. Engrs. Discusses the difficulties that arise in working boilers, due to impure water, and discusses in detail the various objectionable qualities found in feed waters, and the remedies. 3000 w. Elect'n, Lond—Jan. 17, 1902. No. 45763 A.

Some Rudimentary Considerations Con-

*We supply copies of these articles. See page 969.*

cerning the Treatment of Water for Locomotive Use. R. P. C. Sanderson. Some points on methods of water doctoring are discussed. 1500 w. Am Engr & R R Jour—Jan., 1902. No. 45312 C.

**Governors.**

Investigations of Inertia Governors for Steam Engines (Untersuchung der Beharrungsregler an Dampfmaschinen). C. Körner. A theoretical and mathematical study, with figures. 5000 w. Zeitschr d Ver Deutscher Ing—Dec. 28, 1901. No. 45603 D.

Shaft Governors—Some Troubles with Them. Hubert E. Collins. Gives experiences and points out, in a general way a few rules to be observed, and how to handle some of the makes in general use. 1400 w. Engr, U S A—Jan. 15, 1902. No. 45597.

**High-Speed.**

High-Speed Steam Engines. John Davidson. Read before the Liverpool Engng. Soc. Deals generally with engines of the quick-revolution type, setting forth their advantages over the slow revolution type. 1200 w. Engr, Lond—Jan. 3, 1902. Serial. 1 t part. No. 45440 A.

**Liquid Fuel.**

Liquid Fuel for Steam Boilers, Forges, and Furnaces. W. H. Wakeman. Reviews the history of the use of crude oil, and describes the commonly used instruments for drilling oil wells, the process of distillation, oil burners, etc., giving cautions regarding safety in the use. Ill. 5800 w. Engr, U S A—Jan. 1, 1902. Special number. No. 45575 C.

Test of Texas Oil. An account of a comparative test with coal and oil, and the results. Ill. 2700 w. Ir Age—Jan. 30, 1902. No. 45784.

**Rolling Mill Engine.**

Triple Rolling Mill Engine. Gives drawings and comparison with the Neepsend rolling mill engine. 1200 w. Engr, Lond—Jan. 17, 1902. No. 45778 A.

**Safety Valves.**

The Size of Lever Safety Valves. R. A. Douglass. Discusses methods of determining the discharging capacity of safety valves. Ill. 3000 w. Am Elect'n—Jan., 1902. No. 45329.

**Smoke Prevention.**

The Schulz-Knaudt Smoke Prevention Apparatus (Rauchverhütungsvorrichtung der Firma Schulz-Knaudt in Essen). Trnovsky. A short, illustrated description abstracted from the *Zeitschrift des Baierischen Dampfkessel-Revisionsvereines.* There is a combustion chamber behind the grate, fed with air from above. Results of successful tests are given. 600 w. Oester Wochenschr f d Oeffent Baudienst—Dec. 14, 1901. No. 45690 B.

**Speed Regulation.**

The Experimental Determination of the Regulation of Steam Engine Speeds (Une Methode de Mesure Expérimentale de la Régularité des Machines à Vapeurs). M. L. E. F. David. The angular variations of a single revolution are measured by the vibrations of a tuning fork. 1200 w., 23 plates. Bull Soc Internationale Electriciens, and Atlas Nos 9 & 9 bis—Nov., 1901. No. 45801. Each E.

**Steam Engines.**

See Automobiles.

**Steam Generation.**

Some Notes on the Generation of Steam and Its Economical Application. H. A. Clark. Abstract of a paper presented to the Yorkshire College Engng Soc. 2100 w. Horseless Age—Jan. 8, 1902. No. 45375.

The Hoffman System of Steam Generation. Jos. W. Jones. An illustrated description of a system combining to a certain extent the good features of the gasoline and steam systems. Claims very high thermal efficiency and consequent fuel economy. 1000 w. Horseless Age—Dec. 25, 1901. No. 45236.

**Steam Turbines.**

Industrial Applications of Parson's Steam Turbines (Applications Industrielles des Turbines à Vapeur Parsons). M. Duchanoy. A well illustrated account of various applications of steam turbines to dynamo-driving and ship propulsion. 5000 w. Génie Civil—Dec. 21, 1901. No. 45657 D.

**Superheating.**

Superheated Steam and the Schwoerer Superheater (La Vapeur Surchauffee et le Surchauffeur Schwoerer). Abstract of a paper by M. Nolet on superheated steam and the results obtained with the Schwoerer superheater. 3500 w. Revue Technique—Dec. 10, 1901. No. 45666 D.

**Valve Gear.**

The Corliss Valve Gear. J. Begtrup. Illustrated descriptions of the Corliss valves discussing their limitations, dimensions, etc. 3200 w. Am Mach—Jan. 23, 1902. No. 45595.

## MISCELLANY.

**Aeronautics.**

Some Aeronautical Experiments. Wilbur Wright. An interesting illustrated address reviewing the difficulties met and the work of various aeronauts, and giving an account of the experiments made by the writer. 8800 w. Jour W Soc of Engrs—Dec. 1, 1901. No. 45305 D.

Travel in Air. I. Lancaster. An examination of the action of birds with a view of discovering how their flight is controlled. 4500 w. Engr, Lond—Dec. 20, 1901. No. 45281 A.

*We supply copies of these articles. See page 969.*

**Cooling.**

Cooling Power and Conductivity of Air (Pouvoir Refroidissant et Conductibilité de l'Air). P. Compan. Note of experiments on the cooling off of a copper ball in a glass globe filled with dry air. 500 w. Comptes Rendus—Dec. 23, 1901. No. 45842 D.

**Grain Storage.**

Grain Storage in Elevators on the Huart System (La Conservation des Grains dans les Greniers du Système Huart). G. Espitallier. Review of an article by M. Adrian in the *Revue du Service de l'Intendance*, giving an illustrated description of this system, in which the grain is stored in large metal bins and changed from one to another every week or two. 1400 w. Génie Civil—Jan. 4, 1902. No. 45663 D.

**Heating.**

Central Station Heating (Fernheizwerke). An account of a large steam plant for heating various public buildings in Dresden, Saxony. 1500 w. Zeitschr d Ver Deutscher Ing—Jan. 4, 1902. No. 45609 D.

Hot Water Indirect Heating in a Rochester School. Describes the interesting features of the installation. Ill. 2000 w. Eng Rec—Jan. 4, 1902. No. 45343.

Lighting, Heating and Ventilation in the Nassau County Court House, Mineola, N. Y. The heating is largely by means of direct-indirect radiation, and lighted by electricity. Illustrated description. 2200 w. Eng Rec—Jan. 18, 1902. No. 45720.

The Cooling-Off and Heating of Closed Spaces Ueber Abkühlung und Erwärmung geschlossener Räume). Dr. G. Recknagel. A theoretical, mathematical article. This part discusses the loss of heat from closed rooms, taking into account interior and external temperatures, fall of temperature in the walls, etc. 6000 w. Zeitschr d Ver Deutschr Ing—Dec. 21, 1901. No. 45600 D.

The Temporary Warming of the Large Hall of the Palace Library, Vienna, Austria. Prof. Edward Meter. Read before the Am. Soc. of Heat & Ven. Engrs. Describes an interesting piece of work to meet unusual conditions. 1100 w. Met Work—Jan. 25, 1902. No. 45700.

**Hot Water.**

Note on the Flow of Hot Water through and from Pipes (Note sur l'Ecoulement de l'Eau Chaude par les Tuyères). A. Rateau. An explanation, by means of the entropy diagram, of some hot-water and steam flow phenomena observed by M.M. Savage and Pulin in 1892. Diagrams. 2400 w. Revue de Mecanique—Dec. 31, 1901. No. 45675 E+F.

**Mechanical Plant.**

Mechanical Installation in the Modern Office Building. Continued discussion of paper by Charles G. Darrach. 6500 w. Pro Am Soc of Civ Engrs—Dec. 1901. No. 45219 E.

**Nail Manufacture.**

The Walloon Nail Industry (Die Nagelschmieden der Wallonen). C. Ritter von Schwarz. An illustrated account of primitive nail manufacturing carried on in some districts of Belgium. Serial. 2 parts. 7000 w. Stahl u Eisen—Jan. 1, 15, 1902. No. 45638 D.

**Radiation.**

Modern Radiation Investigations (Ergebnisse der Neueren Strahlungsmessungen). Dr. Clemens Schaefer. Modern theories of radiation, the relation between wave length and temperature of light and heat rays, etc., with figures and tables. 4500 w. Zeitschr d Ver Deutscher Ing—Jan. 4, 1902. No. 45607 D.

**Refrigeration.**

Cooling Plant in Butterine Factory. Illustrates and describes the refrigerating and power plant of the Capital City Dairy Co., Columbus, O. 2300 w. Ice & Refrig—Jan., 1902. No. 45364 C.

**Sugar Machinery.**

The Evaporation of Juice. A. E. Jordan. On the importance of adopting a more economical apparatus 10r the evaporation of the water contained in juice. Gives illustrations and descriptions of the most modern evaporators, the present article presenting the Yaryan, and the Lillie types. 3800 w. Engng—Jan. 3, 1902. Serial. 1st part. No. 45428 A.

**Ventilating Fans.**

See Mechanical Engineering, Hydraulics.

**Ventilation.**

Hospitals and Contagious Diseases and Their Ventilation. Thomas Barwick. Read before the Am. Soc. of Heat & Ven. Engrs. Describes the best design for such buildings and the details of a ventilating system. 1800 w. Met Work—Jan. 25, 1902. No. 45701.

The Proper Method of Heating and Ventilating Public Buildings. Gives the views of Prof. S. Homer Woodbridge of the Massachusetts Inst. of Technology, who has recently had charge of the ventilation of the Capitol at Washington. 1600 w. Dom Engng—Jan. 15, 1902. No. 45580 C.

**Water Softening.**

The Largest Water Softening Plant in the World. Illustrated account of the plant at Otterbourne, near Southampton, England, which treats over four million gallons a day. 3300 w. Ir & Coal Trds Rev—Jan. 17, 1902. No. 45,774.

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# MINING AND METALLURGY

## COAL AND COKE.

**Alabama.**

Alabama Coal Mining. Neill Hutchings. Describes some general features of the developments in the Pratt Seam in the Birmingham District, Ala. 1800 w. Mines & Min—Jan., 1902. No. 45387 C.

**British Columbia.**

Coal Discoveries in British Columbia. An account of a recent trip into the center of the province, with particulars of the coal discoveries. 1800 w. Col Guard—Dec. 20, 1901. No. 45274 A.

**Coal Cutting.**

A German Report on Coal-Cutting Machinery in America. Excerpts from the report of Herr R. Mellin, which appeared in *Glückauf* of Dec. 7, 1901. Describes the conditions, methods of working, etc., and gives conclusions regarding the use of these machines in Germany. Comments also on various types. 3300 w. Col Guard—Jan. 17, 1902. No. 45772 A.

**Coal-Fields.**

The Coal Fields of Las Esperanzas, Coahuila, Mex. Edwin Ludlow. Describes the formation of this basin; the characteristic feature is the 1,150 ft. of shale underlying the heavy sandstones. Also gives an illustrated description of the operations. 5000 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 45787 D.

**Coal Washing.**

Washing of Bituminous Coals by the Luhrig Process. J. V. Schaefer. Briefly discusses coal-washing in general and the appliances used, and gives an illustrated detailed description of a Luhrig plant and its operation. Also discussion. 7500 w. Jour W Soc of Engrs—Dec. 1901. No. 45306 D.

**Screen.**

The New Seltner Coal Screen (Der Neue Sortirrost "Patent Seltner"). Erich Mladek. Illustrated description of a coal-separating screen in successful use in Austria. 1 plate. 1000 w. Oesterr Zeitschr f Berg u Hüttenwesen—Dec. 28, 1901. No. 45833 B.

**Slate Pickers.**

American Slate Pickers. Briefly describes some of the machines which have given good results. 1500 w. Col Guard—Jan. 17, 1902. No. 45773 A.

## COPPER.

**Butte, Montana.**

The Gem-Jessie Copper and Silver Group at Butte. Map and information concerning a new group of copper mines which have become very interesting of late. The veins are true fissure veins; strong well-defined copper veins, carrying a higher percentage of silver than the more southern veins. 600 w. Eng & Min Jour—Jan. 18, 1902. No. 45564.

**Japan.**

Copper Mining in Japan. E. W. Nardin. Abstract of a paper read before the Royal Society of New South Wales. An account of the Ashio Mine, the largest producer of copper in the Empire, the manner of working, treatment of the ore, &c. 2600 w. Eng & Min Jour—Dec. 28, 1901. No. 45241.

**1901.**

Copper in 1901. Reports a moderate decrease for the first time for a number of years, discussing the production of various districts. Also reviews the market. 3500 w. Eng & Min Jour—Jan. 4, 1902. No. 45463.

**Selector.**

The David Selector and the Metallurgy of Copper. Illustrates and describes an invention that has brought success in the application of the Bessemer process to the metallurgy of copper. 700 w. Sci Am Sup—Jan. 25, 1902. No. 45706.

## GOLD AND SILVER.

**Assaying.**

The Detection and Estimation of Small Quantities of Gold and Silver. Luther Wagoner. A detailed account of method employed in measuring approximately the amount of gold and silver contained in one cubic centimeter of sea-water, and some of the results obtained. 4000 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 45789 D.

**British Columbia.**

A Review of Mining Operations in Boundary District, During 1901. E. Jacobs. Ill. 3700 w. B. C. Min Rec—Jan., 1902. No. 45451 C.

British Columbia—Vancouver Island Mines and Prospects. William M. Brewer. An account of a recent visit to the Mount Sicker and the Alberni Canal mining districts. Map. 4400 w. Eng & Min Jour—Dec. 28, 1901. No. 45240.

Notes to Accompany One Plan and Three Vertical Sections of the Athabasca Mine, on Toad Mountain, near Nelson, British Columbia. E. Nelson Fell. 1100

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w. Can Min Rev—Dec. 31, 1901. No. 45354 B.

Notes on Recent Progress in the Lardeau District. J. McLellan. Briefly describes characteristics of this district which yields gold and silver ores and many minerals of value. Ill. 1700 w. B C Min Rec—Jan., 1902. No. 45452 C.

**Cyanide Process.**

A Method of Testing Cyanide Solutions Containing Zinc. Leonard M. Green. Read before the Inst. of Min. & Met., London. Proposes a method of analysis by which satisfactory technical results can be obtained with a fair degree of accuracy and in a reasonably short time. 1100 w. Min Rept—Dec., 1901. Serial. 1st part. No. 45529.

A Review of Progress in the Cyanide Process During the Year 1901. J. S. C. Wells. An account of the decided progress in the United States and Canada, reporting concerning the various localities. 7000 w. Eng & Min Jour—Jan. 4, 1902. No. 45462.

The Cyanide-Assay for Copper. Harry Huntington Miller. Describes a method used in employing the cyanide-assay to make a large number of determinations of very low-grade materials whose accuracy within one or two hundredths per cent. was necessary. 1800 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 45790 D.

The Cyanide Process. C. A. Mulholland. Extracts from a paper read before the Sydney Tech. Col. Min. & Met. Soc. Some theoretical considerations on the solution of gold in this process. 2400 w. Aust Min Stand—Nov. 28, 1901. No. 45526 B.

**Egypt.**

Gold Mining in Egypt. Charles J. Alford. Abstract of a paper read before the Inst. of Min. & Met. in London. From the report of an expedition sent out in the winter of 1899-1900, with description of subsequent explorations. Ill. 4700 w. Eng & Min Jour—Jan. 18, 1902. No. 45562.

**Low Grade Silver.**

Mills of the San Juan Region, Colorado. Frank Hartman. Illustrated description of the means by which the great low-grade silver deposits have been made profitable. 2300 w. Mines & Min—Jan., 1902. No. 45385 C.

**Mexico.**

The Mining District of Pachuca, Mexico. Ezequiel Ordonez. Gives a general description, the history, topography, geology, vein-phenomena, &c. Gold, silver, and other metals are found. 7000 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 45797 D.

**New South Wales.**

The Kiandra (N. S. W.) Field. E. C. Andrews. Gives the history of this gold field, describing the formation in the present article. 3000 w. Aust Min Stand—Nov. 28, 1901. Serial. 1st part. No. 45525 B.

**Ore Treatment.**

Ore Treatment in Westralia. Donald Clark. An illustrated description of the filter press processes for gold slimes. 2700 w. Aust Min Stand—Dec. 5, 1901. No. 45415 B.

**Placers.**

The Breckenridge, Colorado, Placer Problem. Wade L. Crow. Abstracts from the Colorado School of Mines Bulletin No. 3. A description of the deposits of the low flats and bars, with a discussion of the different methods of exploitation attempted. Ill. 3000 w. Min Rept—Jan. 9, 1902. Special number. No. 45495 C.

**Review.**

Gold and Silver in 1901. A review of the production during the year, in the United States, and the other parts of the world. Also considers the commercial movement. 5200 w. Eng & Min Jour—Jan. 4, 1902. No. 45461.

**Slimes.**

The Treatment of Clay-Slimes by the Cyanide Process and Agitation. E. A. H. Tays and F. A. Schiertz. Describes the character of the slimes, and their successful treatment. The material was very unfavorable but held high gold values. Ill. 9500 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 45799 D.

**Stamp-Batteries.**

The Pachuca Stamp-Battery and Its Predecessors. M. P. Boss. An outline of the evolution of the stamp-battery. 1400 w. Trans Am Inst of Min Engrs—Nov. 1901. No. 45792 D.

**Tailings.**

The Treatment of Tailings by the Cyanide Process at the Athabasca Mine, near Nelson, British Columbia. E. Nelson Fell. Describes the principal features of this plant for treating gold ores, and the methods employed in its operation. Ill. 3900 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 45796 D.

## IRON AND STEEL.

**Analysis.**

Variations of Carbon and Phosphorus in Steel (Schwankungen von Kohlenstoff und Phosphor im Flusseisen). Axel Wahlberg. Paper before the Iron and Steel Institute giving the results of careful analyses made by eminent chemists, showing the variations. Tables. 4500 w. Stahl u Eisen—Jan. 15, 1902. No. 45656 D.

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**Austria-Hungary.**

The Production of Steel during the Nineteenth Century in Austria-Hungary (Die Erzeugung von Flusseisen und Stahl im XIX. Jahrhundert in Oesterreich-Ungarn). Franz Kupelwieser. Statistical tables, with discussion, showing the preponderance of basic open-hearth steel. 2500 w. Oesterr Zeitschr f Berg u Hüttenwesen—Dec. 14, 1901. No. 45828 B.

**Blast Furnaces.**

Operation of Blast Furnaces (Bedingungen eines Guten Hochofenganges). G. Teichgräber. Practical points on blast furnace working, advocating the periodic changing of the blast pressure. 800 w. Stahl u Eisen—Jan. 15, 1902. No. 45654 D.

The Blast-Furnace Plant at Porto Vecchio, Italy (Die Hochofenanlage von Portovecchio). George Martin. An illustrated description of a blast furnace and pipe casting works on the west coast of Italy, using ore from Elba. 1600 w. Stahl u Eisen—Jan. 15, 1902. No. 45652 D.

The Eliza Blast Furnaces (Die Eliza-Hochofenanlage). Fritz W. Lürmann. Review of an article in the *Iron Age*, giving an illustrated description of the Jones and Laughlin's blast furnaces near Pittsburg. 2200 w. Stahl u Eisen—Jan. 15, 1902. No. 45653 D.

**Crucible Steel.**

Crucible Steel. Its Manufacture and Treatment. David Flather. Abstract of a paper read before the South Staffordshire Iron & Steel Inst. Briefly considers the process of manufacture, its uses and treatment by the consumer. 7000 w. Ir & Coal Trds Rev—Dec. 20, 1901.. Serial. 1st part. No. 45272 A.

**Foundry Iron.**

The Manufacture of Foundry Pig Iron and Foundry Practice in General (Herstellung von Giessereiroheisen und der Giessereibetrieb im Allgemeinen). Hr. Grau. An historical review of blast furnace practice in Germany and an account of foundry practice. Paper before the "Eisenhütte Oberschlesien," with discussion and illustrations. 6000 w. Stahl u Eisen—Jan. 1, 1902. No. 45636 D.

**Furnace Linings.**

Refractory Materials. Percy Longmuir. A brief review of these materials and their general properties, showing the treatment needed to prepare them for industrial conditions. 2300 w. Ir Trd Rev—Jan. 23, 1902. No. 45585.

**Germany.**

Production of Iron and Steel in Germany and Luxemburg (Zehnjährige Uebersicht der Gesamtproduktion an Eisen im Deutschen Zollgebiet einschl. Luxemburg). Statistical tables for the years from 1890 to 1900, of the production of iron ore, iron and steel. 400 w. Glückauf—Nov. 23, 1901. No. 45644 B.

**Iron Trade.**

See Industrial Economics.

**Ladle Crane.**

Revolving Crane for Ladle (Giess-Rollkrahn). Ad. Schuchart, Sr. An illustrated description of a revolving crane carrying a pouring ladle serving two open-hearth furnaces at the Harkort works at Wetter-on-the-Ruhr, Germany. 1 plate. 500 w. Stahl u Eisen—Jan. 15, 1902. No. 45655 D.

**Liquid Fuel.**

Naphtha Fuel for Open-Hearth Furnaces (Naphthafeuerung für Martinöfen). Adrian Byström. From *Jernkontorets Annaler*. An illustrated description of methods of using oil fuel in metallurgical work in Russia. 1000 w. Glückauf—Nov. 23, 1901. No. 45643 B.

**Old Rails.**

The Re-Rolling of Old Rails (Das Neuwalzen infolge Langen Gebrauches Deformirter Eisenbahnschienen). Hr. Litschauer. From the *Bány. Koh. Lapok*. A note on the early re-rolling of worn rails at the Salgo-Tarjaner works in Hungary, with illustrations of rail sections. 300 w. Oesterr Zeitschr f Berg u Hüttenwesen—Dec. 21, 1901. No. 45832 B.

**Pig Iron.**

The Pig Irons of the Sieg District and their Utilization (Das Roheisen des Siegerlandes und seine Verarbeitung). Hr. Münker. An account of the different varieties of pig iron made in this Rhenish-Prussian district, and of their further use in the manufacture of iron and steel. 1400 w. Zeitschr d Ver Deutschr Ing—Dec. 28, 1901. No. 45604 D.

**Rail Rolling.**

Rolling Rails at Low Temperature. Editorial review of article by S. S. Martin, published in the Iron Age and the Railroad Gazette. 1800 w. R R Gaz—Jan. 24, 1902. No. 45737.

**Standardization.**

Standardization of Tests for Iron and Steel. W. H. Farnell. Read before the W. of Scotland Iron & Steel Inst. Discusses the present practice showing the necessity of standardization, and considering the requirements and test limits. 4500 w. Ir & Coal Trds Rev—Dec. 20, 1901. No. 45270 A.

**Steel.**

The Heat Treatment of Steel. M. E. Vanderheym. On the advantages of annealing and rapid cooling. 1800 w. Ir Age—Jan. 30, 1902. No. 45785.

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**Steel Manufacture.**

The Talbot and the Combined Bessemer-Martin Process (Talbotverfaren und Combinirter Bessemer-Martin-Process). E. Holz. A paper before the "Eisenhütte Oberschlesien" on steel manufacture, particularly at Witkowitz, Austria, with discussion. 3500 w. Stahl u Eisen—Jan. 1, 1902. No. 45635 D.

**Steel Works.**

The Clarence Works of Bell Brothers, Limited. An illustrated historical sketch of these works and the successive steps by which this important business has been built. 3000 w. Ir & Coal Trds Rev—Jan. 10, 1902. No. 45544 A.

The Dominion Iron and Steel Company. An illustrated sketch of a great industrial enterprise at Sidney, Nova Scotia. 3400 w. Marine Rev—Jan. 2, 1902. No. 45339.

**Tool Steel.**

Alloyed Tool Steel. H. W. Rushmer. Read at meeting of the Railroad Master Blacksmiths' Assn. Discusses the properties of alloy tool steel, and the principles of working this material. 2300 w. Min Rept—Jan. 2, 1902. No. 45362.

## MINING.

**Accidents.**

The Prussian Mine Accident Commission (Die Verhandlungen und Untersuchungen der Preussischen Stein-und Kohlenfall-Kommission). An account of the proceedings and investigations and regulations of a Prussian commission appointed to investigate accidents due to the fall of rock and coal in mines. Tables. 3000 w. Glückauf—Jan. 4, 1902. No. 45648 B.

**Air Compressors.**

New Collmann Air Compressors at German Collieries. P. Schulte in *Glückauf*. Illustrated description. 1200 w. Col Guard—Dec. 20, 1901. No. 45273 A.

**British Columbia.**

The British Columbia Mining Industry in 1901. William M. Brewer. Review of the conditions in the mining districts, the production and matters affecting the industry. 8000 w. Eng & Min Jour—Jan. 4, 1902. No. 45465.

**Disasters.**

Disaster at Pocahontas Mines. Charles S. Thorne. An account of the disasters occurring on Nov. 14 and 22. 1500 w. Mines & Min—Jan., 1902. No. 45389 C.

The Donibristle Colliery Accident. Gives description of the colliery, and an account of the accident, which was caused by a flow of soft peat or moss into the mine causing the loss of eight lives. Ill. 5500 w. Col Guard—Jan. 3, 1902. No. 45426 A.

**Economies.**

Small Things in Mining. W. H. Storms. Describes devices recently introduced in California for expediting matters in shaft-sinking 1500 w. Min & Sci Pr—Dec. 26, 1901. No. 45350.

**Firedamp.**

The Graduation of Firedamp Test Pipettes (Un Nouveau Mode de Graduation des Eprouvettes à Grison). J. Potier. The graduations indicate directly the inflammable limits of the mixture. 2500 w. 1 plate. Rev Univ des Mines—Dec., 1901. No. 45805 H.

The von Walcher-Gaertner Pneumatophor (Der v. Walcher-Gaertnersche Pneumatophor). Dr. Gustav Gaertner. An answer to R. Daniloff's criticism of this apparatus for breathing in an atmosphere of poisonous gases. 2400 w. Oesterr Zeitschr f Berg u Hüttenwesen—Dec. 28, 1901. No. 45834 B.

**Haulage.**

See Electrical Engineering Power Applications.

**Health.**

See Industrial Economics.

**Hoisting.**

Apparatus to Prevent Mine Cages from Stopping too Hard (Vorrichtung zur Verhütung des Harten Aufsetzens der Fördergestelle). An illustrated description of a delayed-action catch, which does not stop the cage if it is going too fast, the invention of J. Römer. 500 w. Glückauf—Dec. 21, 1901. No. 45646 B.

**Hoisting Diagrams.**

Speed Curves of Hoisting Engines and their Use in Designing Safety Appliances (Die Graphische Darstellung des Ganges des Fördermaschinen und die Benutzung derselben zum Bau eines Sicherheitsapparates). Hr. Witte. An account of experiments with a Karlik mercury tachograph and electrically-operated safety brakes for hoisting engines for mines. Diagrams. 2 plates. 2400 w. Glückauf—Jan. 11, 1902. No. 45651 B.

**Hydraulic Filling.**

The Hydraulic Filling-In of Coal Mine Workings at Myslowitz, Silesia (Scheibenförmiger Abbau Mächtiger Flötze unter Anwendung von Versatz mittelst Wasserspülung auf dem Steinkohlenbergwerk Myslowitz bei Myslowitz). Gustav Williger. From the *Zeitschrift des Oberschlesischen Berg-und Hüttenmännischen Vereins*, giving a description of mining thick seams by taking out layers and filling in with sand and waste material hydraulically. 3000 w. Glückauf—Jan. 4, 1902. No. 45649 B.

**Mexico.**

Notes on the Mines and Minerals of

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Guanajuato, Mexico. William P. Blake. Brief historical notes with account of the systems of mining and the minerals found. 2800 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 45791 D.

The Values of Ores in Mexico. N. H. Emmons. An explanation of the peculiar conditions in Mexico which determine the value of a given ore to the miner. 2300 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 45793 D.

**Mine Drainage.**

Mine Drainage in the Rocky Mountain Region. A. W. Warwick. Gives an idea of the immense expense in handling the water of mines, and describes the methods of pumping now in use, discussing their efficiency, and means of more economical working. Ill. 4700 w. Min Rept—Jan. 9, 1902. Special No. No. 45496 C.

**Mine Fire.**

The Smuggler Union Mine Fire. An account from the Inspector's report to the Commissioner of Mines, describing the disaster and discussing the causes which resulted in such large fatalities. 1800 w. Mines & Min—Jan., 1902. No. 45391 C.

**Mine Patents.**

The Cost of Mine Patents. Theodore F. Van Wagenen. A discussion of the mine patenting system, as now operated, the improvements needed and the benefits that would follow. 3800 w. Min & Sci Pr—Jan. 4, 1902. No. 45378.

**Oil Wells.**

The Drilling of Submarine Oil Wells as Performed at Summerland, Cal. Dwight Kempton. Illustrated description of method used. 800 w. Sci Am—Jan. 18, 1902. No. 45514.

**Ore Deposits.**

Recent Progress in the Study of Ore Deposits. T. A. Rickard. Concerning recent progress in the study of ore deposits, and the assistance geology has given to mining. 1700 w. Eng & Min Jour—Jan. 18, 1902. No. 45563.

**Ore Estimates.**

Ore in Sight. J. D. Kendall. Read before the Inst. of Min. & Met. Recommendations tending to reduce the losses due to errors in estimating. Ill. 2800 w. Ir & Coal Trds Rev—Dec. 20, 1901. No. 45269 A.

**Shaft Sinking.**

Arrangements for Keeping a Borehole Clear During Shaft Sinking (Verfahren und Einrichtung, beim Abteufen von Schächten ein Vorhandenes Bohrloch behufs Ungestörter Wasserlosung Intact zu Erhalten). Eduard Grosse and Josef Srb. The borehole is kept open in order to permit water to drain off, by inserting an inner tube, through which water is pumped. 1000 w. Oesterr Zeitschr f Berg u Hüttenwesen—Dec. 21, 1901. No. 45831 B.

**Shafts.**

Plumbing Deep Shafts of the Tamarack Mine. H. M. Lane. Describes the methods employed and gives an account of some interesting phenomena observed. 4400 w. Mines & Min—Jan., 1902. No. 45384 C.

**Structural Steel.**

The Uses of Structural Steel for Mining, Milling and Smelting Purposes. E. M. Sprague. The practice of making mining plants practically fireproof has led to the use of this material in the construction of buildings for smelters, cyanide mills, chlorination mills, stamp mills, reduction works, refineries, shaft houses, power houses, gallows frames, etc. 2000 w. Min Rept—Jan. 9, 1902. Special No. No. 45497 C.

**Temperature.**

Temperature Measurements in Deep Borings (Temperaturmessungen in Tiefbohrlöchern). H. Thumann. An illustrated description of a thermometric apparatus for deep boreholes with an account of subterranean temperature measurements in a boring at Oldau, Germany. 1400 w. Glückauf—Dec. 21, 1901. No. 45645 B.

**Veins.**

Influences of Country-Rock on Mineral Veins. Walter Harvey Weed. Notes and facts seeming to show a relation between the country-rock and the universal contents of veins. A discussion with conclusions. Ill. 6000 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 45788 D.

## MISCELLANY.

**Aluminum.**

Aluminum. Notes on Its Production, Properties and Use. W. Murray Morrison. Abstract of a paper read before the Glasgow Sec. of the Inst. of Elec. Engrs. Considers the price, the reduction of the metal, leading properties, alloys, &c. 1800 w. Elec Engr Lond—Dec. 20, 1901. No. 45257 A.

**Austria.**

The Mining Industry of Austria in 1900 (Der Bergwerksbetrieb Oesterreichs im Jahre 1900). Statistics of the mining and metallurgical products of all kinds, with tables. 2 parts. 4500 w. Oesterr Zeitschr f Berg u Hüttenwesen—Dec. 14, 21, 1901. No. 45829 each B.

**Concentration.**

Concentration Practice in Southeast Missouri. R. B. Brinsmade. An illustrated description of the plants of the St. Joe, the Central, and the National Concentrating mills. The gangue of the ore concentrated is limestone, while the minerals are galena, iron pyrites, and nickel-

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cobalt sulphides. 4500 w. Mines & Min—Jan., 1902. No. 45383 C.

**Italy.**

Mining and Metallurgy in Italy in 1900 (Bergwerks-und Hüttenproduction Italiens 1900). Statistical tables of all kinds of mining and metallurgical products. 400 w. Oesterr Zeitschr f Berg u Hüttenwesen—Dec. 14, 1901. No. 45830 B.

**Lead Mining.**

The Linares Lead Mining Industry of Spain. E. Mackay-Heriot. Information concerning the geological features, production, and working of this district. 2400 w. Eng & Min Jour—Jan. 11, 1902. No. 45506.

**Mexican Meeting.**

The Mexican Meeting of the American Institute of Mining Engineers. Fritz J. Frank. An illustrated account of an interesting and enjoyable trip. 5500 w. Mines & Min—Jan., 1902. No. 45390 C.

**Mexico.**

Gems and Precious Stones of Mexico. George Frederick Kunz. A review of the gems known to have been found, and description of the mines, giving much interesting information. 15400 w. Trans Am Inst of Min Engrs—Nov., 1901. No. 45798 D.

**Mica.**

Opportunities for Improvement in Mica Mining. George W. Colles. A timely presentation of a subject which owes its importance to the new and widely increasing field of usefulness of mica as an electrical insulator. 4000 w. Engineering Magazine—Feb., 1902. No. 45826 B.

**Petroleum.**

Oil and Gas in the Kansas-Indian Territory and Texas Fields. Information from a bulletin by George I. Adams, issued by the United States Geological Survey. 1600 w. Eng & Min Jour—Jan. 18, 1902. No. 45561.

Oil in Colorado. Arthur Lakes. Discusses the geology of the deposits, and the various horizons in which signs of oil have been found. 2500 w. Mines & Min—Jan., 1902. No. 45388 C.

**Platinum.**

The Discovery of Platinum in Wyoming. Wilbur C. Knight. An account of the discovery with assays made from samples. 800 w. Eng & Min Jour—Dec. 28, 1901. No. 45239.

**Quicksilver.**

New Method of Quicksilver Extraction. J. H. Jory. Describes the method and states its advantages. The most essential part of the new method is the electrolytic sluice. 1500 w. Min & Sci Pr—Dec. 28, 1901. No. 45349.

Quicksilver. R. S. Baverstock. Discusses its occurrence, characteristics, production, methods of reducing ores, uses, &c. 3800 w. Min & Sci Pr—Jan. 4, 1902. No. 45376.

Some Occurrences of Gases in a Quicksilver Mine. Phil Rearden. A description of an experience in a California mine, with diagrams. 1000 w. Min & Sci Pr—Jan. 18, 1902. No. 45584.

**Tasmania.**

Wolfram Near Pieman Heads (T.). George A. Waller. Describes the deposits and discusses their origin. 1500 w. Aust Min Stand—Nov. 14, 1901. Serial. 1st part. No. 45264 B.

**Zinc.**

The Missouri and Arkansas Zinc-Mines at the Close of 1900. Eric Hedburg. Discussion of this paper which was read at the Richmond meeting. 3500 w. Trans Am Inst of Min Engrs—Feb., 1902. No. 45795 D.

Zinc Smelting in the United States in 1901. Walter Renton Ingalls. A review of the various districts and the improvements introduced. Ill. 4300 w. Eng & Min Jour—Jan. 4, 1902. No. 45464.

# RAILWAYS AND TRAMWAYS

## CONDUCTING TRANSPORTATION.

**Disaster.**

The Disaster on the Liverpool Overhead Railway. An account of the fire which resulted in the loss of six lives and much damage to the Dingle Station and rolling stock. 2000 w. Elec Rev, Lond—Jan. 3, 1902. No. 45423 A.

**Speed.**

British and American Expresses. Aiming to prove Britain well in advance of America as regards the volume and average speed of her express traffic. 1400 w. Transport—Jan. 10, 1902. No. 45507 A.

The Speed of Express Trains in Europe and the United States (Vitesse de Marche des Trains Express en Europe et aux Etats-Unis). A large table, taken from *"Archiv für Eisenbahnwesen"*, giving comprehensive statistics of fast trains in Europe and America. 1200 w. Revue Technique—Dec. 10, 1901. No. 45668 D.

**Train Resistance.**

New Formulae for Train Resistance (Nouvelles Formules de la Résistance des Trains). A comparison of various train resistance formulae, with diagram. 1000

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w. Génie Civil—Jan. 11, 1902. No. 45-665 D.

**Tunnel Disaster.**

The Fourth Avenue Tunnel Collision. Remarks on the cause of the disaster with editorial discussion. 5000 w. R. R. Gaz—Jan. 17, 1902. No. 45538.

The New York Central Accident—Electricity—Protection by Signals. S. S. Neff. A review of improvements necessary to insure safety on electric roads, with some reference to warnings in letters by Mr. George Westinghouse. 2800 w. R. R. Gaz—Jan. 24, 1902. No. 45734.

The New York Central Tunnel Tragedy. Editorial comments with illustration of the wrecked engine. 800 w. Sci Am—Jan. 18, 1902. No. 45513.

The Park Avenue Tunnel Disaster. Editorial discussion of this recent accident which caused loss of life and serious injuries. 3000 w. Eng News—Jan. 16, 1902. No. 45485.

The Testimony Concerning the Tunnel Collision. Gives the essential parts of the testimony brought out at the Coroner's inquest thus far, with editorial comment on the false impressions formed from the manner of conducting the investigation. 2000 w. R R Gaz—Jan. 24, 1902. No. 45733.

**United States.**

Development of Transportation in the United States. Angus Sinclair. Extracts from paper prepared for the Year Book of the Agricultural Department of the United States. A review of the early history of railroading and locomotive building. Ill. 3500 w. Loc Engng—Jan., 1902. No 45317 C.

**Unloading.**

Method of Unloading Passengers from Moving Trains. Illustrates and describes the use of "saddle cars" successively taken up and dropped from a moving train. 700 w. Sci Am—Jan. 4, 1902. No. 45355.

## MOTIVE POWER AND EQUIPMENT.

**Bergdorf-Thun.**

The Bergdorf-Thun Electric Railway (Le Chemin de Fer Electrique à Voie Normale de Berthoud à Thoune, Suisse). Henry Martin. A very well illustrated description of this Swiss polyphase railway and its rolling stock. 1 plate. 6000 w. Génie Civil—Jan. 11, 1902. No. 45664 D.

**Booster.**

See Electrical Engineering, Distribution.

**Brighton.**

The Brighton Corporation Tramways. Illustrated detailed description of construction. 2800 w. St Ry Jour—Jan. 4, 1902. No. 45319 D.

**Car Equipments.**

Electric Car Equipments and Their Maintenance. A. W. Wigram. Read before the Newcastle section of the Inst. of Elec. Engrs. A criticism on some constructional details prominent in modern practice, and a few notes on maintenance. 9300 w. Elec Engr, Lond—Dec. 27, 1901. No. 45283 A.

**Car Service.**

Mr. Midgley's Car Service Investigations. A review of Mr. J. W. Midgley's seventh circular letter, which discusses plans that have been tried or suggested to promote greater activity in freight car performance. 2000 w. Ry Age—Jan. 17, 1902. No. 45559.

**Cars.**

Pressed Steel Car of 100,000 lbs. Capacity—Car for the Pennsylvania R. R. Illustrations and brief description, with general dimensions. 600 w. Ry & Engng Rev—Jan. 18, 1902. No. 45570.

The "California" or Combination Car. W. E. Partridge. Illustrates and describes this type of car, which has a closed body with open ends or platforms, discussing also similar types. 2200 w. St Ry Rev—Jan. 15, 1902. No. 45567 C.

36-foot Box Car with Steel Center Sills—Chicago, Milwaukee & St. Paul Railroad. Illustrated description. 500 w. R R Gaz.—Jan. 17, 1902. No. 45539.

Vanderbilt Steel Tank Car, 12,000 Gallons Capacity. Illustrated description of a car designed for the Equitable Land and Oil Company, to be used in transporting oil from the Texas oil fields to St. Louis. The largest capacity tank cars in use. 800 w. Am Engr & R R Jour—Jan., 1902. No. 45309 C.

**Detroit.**

Express Service in Detroit. An illustrated description of this service, which has developed rapidly and is growing in popularity. 2000 w. St Ry Rev—Jan. 15, 1902. No. 45568 C.

**Draft Gear.**

Westinghouse Friction Draft Gear (Westinghouse - Reibungs - Zugvorrichtung). An illustrated account of this draft gear and its successful operation. 3000 w. Glasers Ann—Jan. 1, 1902. No. 45613 D.

**Electric Equipment.**

The Electric Equipment of the Manhattan Elevated. A short description of the train equipment, and a more complete illustrated description of the power plant of the New York Elevated railway. 2500 w. R R Gaz—Jan. 17, 1902. No. 45536.

Electrical Equipment of the Manhattan Elevated Railway. Facts and views concerning this important instalation. 1700 w. Elec Wld & Engr—Jan. 11, 1902. Serial. 1st part. No. 45467.

Electric Traction on the Manhattan Elevated Railway (Mittheilungen über

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den Elektrischen Betrieb auf der Manhattan Bahn). Hr. Sarre. An illustrated general account of the electrical equipment of the road and of the power station, with map and diagrams. 2 plates. 3000 w. Glasers Ann—Dec. 15, 1901. No. 45612 D.

**Electric Traction.**

Concerning Some Dangers from Electric Traction. A letter from George Westinghouse, with editorial showing that the use of electricity in the Park Ave. tunnel might have made the recent accident even more serious. 900 w. R R Gaz—Jan. 17, 1902. No. 45535.

Present Tendencies in Electric Traction. Louis Bell. A brief review of the history of electric traction, with a discussion of the present tendencies. 3500 w. Elec Rev, N. Y—Jan. 11, 1902. No. 45457.

**Hamburg, Germany.**

The Street Railway Company of Hamburg, Germany. Heinrich Vellguth. Gives the history of the company, with an illustrated detailed description of the construction and equipment of the tramways and information related. 9400 w. St Ry Jour—Jan. 4, 1902. No. 45318 D.

**Interurban.**

Chicago & Joliet Interurban Railway. A. S. Kibbe. Illustrated description of an interurban road recently opened to service, its construction and equipment. 7000 w. St Ry Rev—Jan. 15, 1902. No. 45565 C.

**Locomotives.**

American Locomotives in England. Charles Rous-Marten. The reply of the writer to an extended criticism called out by an article of his published June 14th, 1901. 4000 w. Engr, Lond—Dec. 20, 1901. No. 45278 A.

Baldwin Eight-Coupled Locomotive for the Lehigh Valley R. R. Illustrated description of a recently built switching engine, interesting because of its type and extreme weight. 900 w. Ry & Engng Rev—Jan. 25, 1902. No. 45782.

Chautauqua Type Passenger Locomotive—Buffalo, Rochester and Pittsburg Railway. Engravings and description of the principal details of these recently built engines. 900 w. Ry Mas Mech—Jan. 1902. No. 45360.

Chautauqua Type Passenger Locomotives. Illustrates and describes the heaviest four-coupled passenger locomotives ever built. Used in service between New York and Philadelphia on the Central Railroad of New Jersey. 900 w. Am Engr & R R Jour—Jan., 1902. No. 45311 C.

Compound Locomotives, and the Richmond Locomotive Exhibit. H. Wade Hibbard. Describes the Pan-American exhibit of the Richmond Works which has been given to Sibley College, with remarks on this class and a statement of its advantages. 1500 w. Sib Jour of Engng—Jan., 1902. No. 45753 C.

Compound Passenger and Goods Locomotives for the Hungarian State Railways. Illustrates and describes an engine with two coupled driving axles, a bogie in front and trailing wheels in the rear, for hauling heavy trains at a high speed. 1200 w. Engng—Dec. 27, 1901. No. 45295 A.

Compound Tank Locomotive, Indian Netherlands Railway, Java. Illustration with description of an engine employed on the Java narrow-gauge railways, and an account of the service. 1000 w. Engr, Lond—Jan. 3, 1902. Serial. 1st part. No. 45439 A.

Electric Breakdown Locomotive. Gives an illustration of an electric locomotive designed for breakdown purposes on the Waterloo and City Railway, London, with description, and notes on the working of this railway. 800 w. Engr, Lond—Jan. 17, 1902. No. 45779 A.

English Locomotives at the Paris Exposition (Die Englischen Locomotiven auf der Pariser Weltausstellung 1900). Rolf Sanzin. Illustrated description of various British locomotives. 7500 w. Zeitschr d Oesterr Ing u Arch Ver—Dec. 27, 1901. No. 45698 B.

European Railway Jottings. Charles Rous-Marten. Discusses the single-driven engines recently built for the Great Northern Railway, and other recent locomotives. 1800 w. Loc Engng—Jan., 1902. No. 45314 C.

Four-Cylinder Balanced Compound Locomotive. Charles M. Muchnic. Engravings illustrating a design based on the principles of the successful de Glehn compounds, combined with the simplicity which characterize American practice. 1500 w. Am Engr & R R Jour—Jan., 1902. No. 45313 C.

Four-Cylinder Compound Decapod Locomotive—Largest Engine Yet Built. Illustrates and describes this interesting engine built for the Atchison, Topeka & Santa Fe Railway, comparing it with other large engines. 2000 w. Ry & Engng Rev—Jan. 11, 1902. No. 45469.

Lignite-Burning Consolidation Locomotive—Bismarck, Washburn & Great Falls. General description, with illustrations, of a recently built locomotive. The first of its kind, as to wheel arrangement, in the United States. 700 w. R R Gaz—Jan. 10, 1902. No. 45480.

Locomotive Construction in the United States (La Construction des Locomotives aux Etats-Unis). Daniel Bellet. An illustrated account of various United States locomotives for domestic and foreign use. 5400 w. Revue Technique—Dec. 25, 1901. No. 45673 D.

New Culm-Burning Switching Locomotive. Describes locomotives of the

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Wootten type, being built for the Delaware & Hudson. Ill. 800 w. Ry Age—Dec. 27, 1901. No. 45238.

Oil-Burning Locomotives on the Southern Pacific. Illustrates and describes oil-burning apparatus used very successfully on the western lines of the Southern Pacific. 800 w. R R Gaz—Jan. 24, 1902. No. 45736.

Passenger Mogul for the New York, Ontario and Western. Illustrated description of a large culm-burning engine for fast freight and passenger service. 1000 w. Ry Age—Jan. 24, 1902. No. 45727.

Prairie Type Passenger Locomotive with Traction Increaser—Atchison, Topeka & Santa Fe. Drawings and description, showing two ways of applying the increasers. Compressed air from the air-brake system is used to operate them. 900 w. R R Gaz—Jan. 17, 1902. No. 45540.

Some Factors Affecting the Power of Locomotives. Abstract of a paper presented by Prof. W. F. M. Goss before the Dec. meeting of the New England R. R. Club, with diagrams. A discussion of the effect of speed on tractive efforts. 4500 w. R R Gaz—Jan. 24, 1902. No. 45735.

Tank Locomotive for the Vajda-Hunyad Mine, Hungary. Illustrated description of these narrow-gauge engines, with four coupled axles, the two end axles being made to pivot for taking short sharp curves. 400 w. Engng—Jan. 3, 1902. No. 45429 A.

**London.**

The City and South London Railway. An interesting illustrated account of the development and improvement of this pioneer electric railway in England, its equipment, operation, &c. 6600 w. Tram & Ry Wld—Dec. 12, 1901. No. 45510 B.

**Lubrication.**

Lubrication of Cars. George P. Zachritz. Extracts from a paper presented at the Dec. meeting of the Northwest Ry. Club. Discusses the things to be considered in successfully and economically preventing journals from heating. 2000 w. R R Gaz—Jan. 24, 1902. No. 45738.

**Paris.**

Development of Street Railway Traffic in Paris. E. J. Lavalard. Reviews the history of the street transportation systems, including the omnibus as well as tramway lines. 1800 w. St Ry Jour—Jan. 4, 1902. No. 45320 D.

**Portsmouth.**

The Portsmouth Electric Tramways. Full illustrated description of these tramways which form the largest municipal system in the South of England. 1700 w. St Ry Jour—Jan. 4, 1902. No. 45323 D.

**Re-arrangement.**

Re-arrangement of Power Generating and Distributing Scheme at Worcester, Mass. Discusses questions involving the relative economy of alternating and direct-current transmission, the utilizing of present power-house equipments when roads are consolidated, output, capacity, &c. Ill. 3000 w. St Ry Rev—Jan. 15, 1902. No. 45569 C.

**Rheydt-Gladbach.**

See Electrical Engineering, Generating Stations.

**Salford.**

Salford Corporation Electric Tramways. History of the tramway service with illustrated description of the recent re-equipment and reconstruction on the overhead wire system. 4000 w. Tram & Ry Wld—Dec. 12, 1901. No. 45411 B.

**San Francisco.**

Rail Feeder Construction in San Francisco. S. L. Foster. An illustrated account of the recent work of the Market Street Railway Company. 1700 w. St Ry Jour—Jan. 4, 1902. No. 45321 D.

**Stray Current.**

Protection of Water Pipe from Electrolysis. E. B. Ellicott. A statement of conditions existing in large cities where electric railways are operated, and the remedy, with general discussion of the subject. Ill. 7500 w. Jour W Soc of Engrs—Dec., 1901. No. 45307 D.

See also Electrical Engineering, Measurement.

**Suspended Railway.**

The Barmen-Elberfeld-Vohwinkel Suspended Railway (Le Chemin de Fer Suspendu de Barmen-Elberfeld-Vohwinkel, Allemagne). Alfred Boudon. A well illustrated description of this interesting German elevated railway, designed by E. Langen. 1 plate. 3500 w. Génie Civil—Dec. 28, 1901. No. 45660 D.

The Langen Suspended Railway of Barmen-Vohwinkel-Elberfeld. Prof. Dolezalek. Illustrated description of the road, equipment and operation. 1000 w. Sci Am—Jan. 25, 1902. No. 45703.

**Tires.**

Flat Spots that Develop in Driving Wheel Tires. I. F. Wallace. Reviews the history of driving wheel tires claiming that it is speed and counter balance combined that cause the trouble. 1500 w. Ry Mas Mech—Jan., 1902. No. 45361.

**Tunnel Equipment.**

Comments on the Electrical Equipment of the New York Central Tunnel. Letters from Mr. George Westinghouse in regard to the dangers of electric traction, with replies from various writers, and editorial. 6000 w. St Ry Jour—Jan. 25, 1902. No. 45722 D.

**Underground.**

The Transformation of the Under-

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ground Railway. A retrospective view of the situation which led to the attitude taken by the Board of Trade is commenced. 1400 w. Elec Rev, Lond—Jan. 3, 1902. Serial. 1st part. No. 45422 A.

**Zossen.**

High-Speed and Long-Distance Electric Railways (Ueber Elektrische Schnell und Fernbahnen). O. Lasche. A paper before the Verein für Eisenbahnkunde, by the chief engineer of the Allemeine Elektrizitätsgesellschaft, giving a general account of the advantages of electric traction, and details of the high-speed experiments between Berlin and Zossen. Diagrams. 6500 w. Glasers Ann—Dec. 15, 1901. No. 45611 D.

## NEW PROJECTS.

**Australia.**

The Trans-Australian Railway Scheme. Stafford Ransome. Map, with account of a proposed plan to connect the capitals of the various states by means of one line of railway reaching from the east to the west coast. 2000 w. Engr, Lond—Dec. 27, 1901. No. 45288 A.

**Extensions.**

The Glasgow and Southwestern's Extensions at Glasgow. An illustrated description of a great terminal enlargement in the heart of a busy city, where the approach is over an important river as well as numerous streets. 2500 w. Transport —Jan. 3, 1902. No. 45412 A.

**Ship Railway.**

See Civil Engineering. Canals, Rivers and Harbors.

## PERMANENT WAY AND BUILDINGS.

**Berlin.**

The Electric Elevated and Underground Railways in Berlin (Die Elektrischen Hoch und Tiefbahnen in Berlin). Hugo Koestler. A very well illustrated account of this rapid transit system. 3 plates. 7500 w. Oesterr Wochenschr f d Oeffent Baudienst—Nov. 23, 1901. No. 45680 B.

**Monorail.**

A Comparison of Single and Double Rail Track (Chemins de Fer à Une et à Deux Files de Rails Comparés). R Philippe. An examination of the resistance of double rail track upon curves of various radii, in comparison with the various monorail systems. 8000 w. 1 plate. Ann des Ponts et Chaussées. 2 Trimestre 1901. No. 45816 E + F.

**New Plant.**

New Yards and Shops of the Central Railroad of New Jersey at Elizabethport, N. J. Illustrations and description. The buildings are of monolithic concrete construction. Explains the traffic conditions that had to be provided for, and much information of the shops and their equipment. 4000 w. R R Gaz—Dec. 27, 1901. Serial. 1st part. No. 45233.

**Rack Railway.**

The Barmen Mountain Railway (Die Barmer Bergbahn). Direktor Daubner. A well illustrated description of this electric railway, partly rack and partly adhesion, between Barmen and some of the neighboring places in Rhenish-Prussia. The power house is also described and load curves given. 3000 w. Zeitschr d Ver Deutscher Ing—Jan. 4, 1902. No. 45606 D.

**Retaining Walls.**

Widening a Section of the New York Rapid Transit Railway by Moving the Side Walls. Illustrated description of the moving of brick-faced concrete retaining walls, placing them on new foundations. 1500 w. Eng News—Jan. 9, 1902. No. 45368.

**Roundhouse.**

Collinwood Roundhouse. Illustrates and describes details and appliances of this interesting terminal on the L. S. & M. S. Ry. 900 w. Am Engr & R R Jour—Jan., 1902. No. 45310 C.

**Shops.**

West Chicago Shop of the Chicago and North-Western Railroad. R. T. Shea. Illustrated detailed description. 2200 w. Loc Engng—Jan., 1902. No. 45315 C.

**Signaling.**

Interlocking and Signal Work on the Union Pacific. Illustrates and describes recent work between Council Bluffs, Ia., and Gilmore, Neb., including the Union Station at Omaha. 1500 w. Ry Age—Jan. 17, 1902. No. 45560.

**Stray Currents.**

See Electrical Engineering, Measurement.

**Surface Contact.**

The Barbillon and Griffisch Surface-Contact Tramway (Traction Electrique des Tramways Système Barbillon et Griffisch par Distributeur Automobile à Echappement). J. Reyval. An illustrated description of a system in which a small electric motor car runs in a closed conduit parallel to the tracks and successively energizes contact plugs between the rails. 2800 w. Revue Technique—Dec. 25, 1901. No. 45670 D.

**Terminal Problem.**

Proposed Solution of the New York Central Terminal Problem. A general outline of the plan proposed for operating the Park Ave. tunnel. 1600 w. Sci Am—Jan. 25, 1902. No. 45704.

**Tracklaying.**

Re-Laying of Rails (Schienen-Neulage). Franz Baumgartner. A practical detailed description of the relaying of railway

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track. 6000 w. Oesterr Wochenschr f d Oeffent Baudienst—Dec. 7, 1901. No. 45-686 B.

**Tunnel Improvement.**

The New York Central's Plans for the Improvement of the Park Ave Tunnel. Announcement of the changes in the method of operating that has been decided upon, with editorial discussion, and report of the investigation of the disaster. 5700 w. Eng News—Jan. 23, 1902. No. 45731.

## TRAFFIC.

**Freight-Car Hire.**

The Per Diem Basis for Settlement of Freight Car Hire. J. M. Daly. A discussion of the advantages and objections relating to this system, generally favorable to its adoption. 3400 w. R. R. Gaz—Jan. 10, 1902. No. 45482.

**Freight-Carrying.**

Electric Roads as Freight Carriers. Editorial discussion of this subject, and the type of road which may find profit in hand-to its adoption. 3400 w. R R Gaz—Jan. 4, 1902. No. 45322 D.

**Freight Interchange.**

Switching Yards of the Chicago Transfer & Clearing Co. Illustrated description of these new switching and transfer yards. The fundamental principle is the reduction of the great delays and expense incurred by the present system. Also editorial discussion. 6800 w. Eng News—Jan. 2, 1902. No. 45346.

**Germany.**

Freight Movement on German Railways (Die Güterbewegung auf Deutschen Eisenbahnen im Jahre 1900 im Vergleich zu der in den Jahren 1899, 1898 und 1897). Statistical tables, particularly of mining and metallurgical products. 600 w. Glückauf—Nov. 23, 1901. No. 45642 B.

**Inter-State Commerce.**

Proposed Amendments of the Inter-State Commerce Act. Walker D. Hines. A protest against the proposed legislation to amend the act, with editorial. 2500 w. Ry & Engng Rev—Jan. 18, 1902. No. 45-571.

**Railway Traffic.**

Railways and Industry. H. T. Newcomb. Reviews the changes brought about by the railway system, especially in America. 2500 w. Gunton's Mag—Jan., 1902. No. 45358 C.

**Rates.**

The Inadequate Powers of the Interstate Commerce Commission. Edward P. Bacon. Discusses the powers of this commission and the proposed amendments, and the subject of railway rates. 5000 w. N Am Rev—Jan., 1902. No. 45303 D.

**Simplon.**

The Lines of Approach to the Simplon (Le Linee di Accesso al Sempione). A report of the discussion in the Chamber of Deputies under which the various Italian railways are to partake in the traffic through the Simplon tunnel. 1000 w. Gior d Lav Pubb e delle Str Ferr—Dec. 25, 1901. No. 45807 D.

## MISCELLANY.

**American Railways.**

Some Notes Suggested by Colonel Constable's Report on American Railways. Colonel G. Boughey. A review of the report named. 3300 w. Transport—Jan. 17, 1902. No. 45762 A.

**Conferences.**

The Indian Locomotive Conference in Calcutta. A report of matters discussed, with editorial. 4800 w. Engr, Lond—Jan. 17, 1902. No. 45776 A.

**Early Railway.**

An Early London Railway. Gives the history of a short line on which the atmospheric system was given a trial in 1837, but proved a failure. The line was opened for traffic in 1844 and its various experiences are narrated. 2800 w. Engr, Lond—Dec. 27, 1901. No. 45293 A.

**East Indies.**

Railways and Steam Tramways of the Dutch East Indies. A report on the railways of Java and Sumatra by J. W. Post, formerly engineer of the State Railways of the Dutch East Indies. 3000 w. Engr, Lond—Dec. 27, 1901. No. 45291 A.

**Italian Railways.**

Convention of the Provincial Administration of Milan, etc. (Convenzioni Stipulate coll' Amministrazione Provinciale di Milano, etc.). A report of the discussion of the joint convention of the provinces of Milan, Turin, and the Italian Mediterranean railways. Two articles. 4000 w. Riv Gen delle Ferrovie—Jan. 5, 12, 1902. No. 45800 each B.

**Portchester Railway.**

The New York and Portchester Railway Hearing. Presents testimony relating to the engineering and financial features of this undertaking. 7000 w. St Ry Jour—Jan. 4, 1902. No. 45325 D.

**Supplies.**

Stock Rooms and Stock Keeping of the Metropolitan Street Railway Company, New York City. An illustrated description of the storerooms, and methods of purchasing and distributing. 2500 w. St Ry Jour—Jan. 4, 1902. No. 45324 D.

**Tube Railways.**

Tube Railways. Editorial called out by the recent accident in the Liverpool elevated railway, discussing the dangers of tube railways, and their construction. 1500 w. Engr, Lond—Jan. 10, 1902. No. 45555 A.

*We supply copies of these articles. See page 969.*

## EXPLANATORY NOTE.

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cts. The letter A, B or C denotes a price of 40 cts.; D, of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H, of $1.60. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

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## THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED.

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the Index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* Boston, U. S. A.
American Electrician. *m.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Gas Light Journal. *w.* New York.
American Geologist. *m.* Minneapolis, U. S. A.
American Jl. of Science. *m.* New Haven, U.S.A.
American Machinist. *w.* New York.
Am. Manufacturer and Iron World. *w.* Pittsburg, U. S. A.
American Shipbuilder. *w.* New York.
American Telephone Journal. *w.* New York.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. d Ing. e d Arch. Ital. *w.* Rome.
Architect. *w.* London.
Architectural Record. *qr.* New York.
Architectural Review. *s-q.* Boston, U. S. A.
Architect's and Builder's Magazine. *m.* New York.
Armee und Marine. *w.* Berlin.
Australian Mining Standard. *w.* Sydney.
Autocar. *w.* Coventry, Eng.
Automobile Magazine. *m.* New York.
Automotor & Horseless Vehicle Jl. *m.* London.
Brick Builder. *m.* Boston, U. S. A.
British Architect. *w.* London.
Brit. Columbia Mining Rec. *m.* Victoria, B. C.
Builder. *w.* London.
Bulletin Am. Iron and Steel Asso. *w.* Philadelphia, U. S. A.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bulletin Scientifique. *m.* Liege.
Bull. Soc. Int. d Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *m.* Montreal.
Canadian Mining Review. *m.* Ottawa.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.
Comptes Rendus de l'Acad. des Sciences. *w.* Paris.
Consular Reports. *m.* Washington.
Contemporary Review. *m.* London.
Deutsche Bauzeitung. *b-w.* Berlin.
Domestic Engineering. *m.* Chicago.
Electrical Engineer. *w.* London.
Electrical Review. *w.* London.
Electrical Review. *w.* New York.
Electrical Times. *w.* London.
Electrical World and Engineer. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.

Electricity. *w.* London.
Electricity. *w.* New York.
Electrochemist & Metallurgist. *m.* London.
Elektrizität. *b-w.* Leipzig.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnische Zeitschrift. *w.* Berlin.
Elettricita. *w.* Milan.
Engineer. *w.* London.
Engineer. *s-m.* Cleveland, U. S. A.
Engineers' Gazette. *m.* London.
Engineering. *w.* London.
Engineering and Mining Journal. *w.* New York.
Engineering Magazine. *m.* New York & London.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penn'a. *m.* Pittsburg, U. S. A.
Fire and Water. *w.* New York.
Foundry. *m.* Cleveland.
Gas Engineers' Mag. *m.* Birmingham.
Gas World. *w.* London.
Génie Civil. *w.* Paris.
Gesundheits-Ingenieur. *s-m.* München.
Giorn. Dei Lav. Pubb. e. d. Str. Ferr. *w.* Rome.
Glaser's Ann. f. Gewerbe & Bauwesen. *s-m.* Berlin.
Horseless Age. *w.* New York.
Ice and Refrigeration. *m.* New York.
Indian and Eastern Engineer. *m.* Calcutta.
Ingeneria. *b-m.* Buenos Ayres.
Ingenieur. *w.* Hague.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron & Steel Trades Journal. *w.* London.
Iron Trade Review. *w.* Cleveland.
Jour. Am. Foundrymen's Assoc. *m.* New York.
Journal Assn. Eng. Societies. *m.* Philadelphia, U.S.A.
Journal of Electricity. *m.* San Francisco.
Journal Franklin Institute. *m.* Philadelphia.
Journal of Gas Lighting. *w.* London.
Journal Royal Inst. of Brit. Arch. *s-qr.* London.
Journal of Sanitary Institute. *qr.* London.
Journal of the Society of Arts. *w.* London.
Journal of U. S. Artillery. *b-m.* Fort Monroe, U.S.A.
Journal Western Soc. of Eng. *b-m.* Chicago.
Journal of Worcester Poly. Inst., Worcester, Mass.
Locomotive. *m.* Hartford, U. S. A.
Locomotive Engineering. *m.* New York.
Machinery. *m.* London.
Machinery. *m.* New York.
Madrid Científico. *t-m.* Madrid.
Marine Engineering. *m.* New York.
Marine Review. *w.* Cleveland, U. S. A.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Metal Worker. *w.* New York.
Métallurgie. *w.* Paris.
Minero Mexicano. *w.* Mexico.
Minerva. *w.* Rome.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. w. San Francisco, U.S.A.
Mining Journal. *w.* London.
Mining Reporter. *w.* Denver, U. S. A.
Mitt. aus d Kgl Tech. Versuchsanst. Berlin.
Mittheilungen des Vereines für die Förderung des Local und Strassenbahnwesens. m. Vienna.
Modern Machinery. *m.* Chicago.
Monatsschr. d Wurtt. Ver. f Baukunde. *m.* Stuttgart.
Moniteur Industriel. *w.* Paris.
Mouvement Maritime. *w.* Brussels.
Municipal Engineering. *m.* Indianapolis, U. S. A.
National Builder. *m.* Chicago.
Nature. *w.* London.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Nineteenth Century. *m.* London.
North American Review. *m.* New York.
Oest. Wochenschr. f. d. Oeff Baudienst. *w.* Vienna.
Oest. Zeitschr. f. Berg- & Hüttenwesen. *w.* Vienna.
Ores and Metals. *w.* Denver, U. S. A.
Plumber and Decorator. *m.* London.
Popular Science Monthly. *m.* New York.
Power. *m.* New York.
Power Quarterly. New York.
Practical Engineer. *w.* London.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Proceedings Engineers' Club. *qr.* Philadelphia, U. S. A.
Pro. St. Louis R'way Club. *m.* St. Louis, U. S. A.
Progressive Age. *s-m.* New York.
Quarry. *m.* London.
Railroad Digest. *w.* New York.
Railroad Gazette. *w.* New York.
Railway Age. *w.* Chicago.
Railway & Engineering Review. *w.* Chicago.
Review of Reviews. *m.* London & New York.
Revista d Obras. Pub. *w.* Madrid.
Revista Tech. ed Agr. *b-m.* Catania.
Revista Tech. Ind. *m.* Barcelona.
Revue de Mécanique. *m.* Paris.
Revue Gen. des Chemins de Fer. *m.* Paris.
Revue Technique. *b-m.* Paris.
Revue Universelle des Mines. *m.* Liége.
Rivista Gen. d Ferrovie. *w.* Florence.
Rivista Marittima. *m.* Rome.
Sanitary Plumber. *s-m.* New York.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Stahl und Eisen. *s-m.* Düsseldorf.
Stevens' Institute Indicator. *qr.* Hoboken, U.S.A.
Stone. *m.* New York.
Street Railway Journal. *m.* New York.
Street Railway Review. *m.* Chicago.
Telephone Magazine. *m.* Chicago.
Telephony. *m.* Chicago.
Tijds. v h Kljk. Inst. v Ing. *qr.* Hague.
Tramway & Railway World. *m.* London.
Trans. Am. Ins. Electrical Eng. *m.* New York.
Trans. Am. Ins. of Mining Eng. New York.
Trans. Am. Soc. of Civil Eng. *m.* New York.
Trans. Am. Soc. of Heat & Ven. Eng. New York.
Trans. Am. Soc. Mech. Engineers. New York.
Trans. Inst. of Engrs. & Shipbuilders in Scotland Glasgow.
Transport. *w.* London.
Western Electrician. *w.* Chicago.
Wiener Bauindustrie Zeitung. *w.* Vienna.
Yacht. *w.* Paris.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschrift für Elektrochemie. *w.* Halle a. S.

# CURRENT RECORD OF NEW BOOKS

*NOTE—Our readers may order through us any book here mentioned, remitting the publisher's price as given in each notice. Checks, Drafts, and Post-Office Orders, home and foreign, should be made payable to* THE ENGINEERING MAGAZINE.

*Autobiography.*

Reminiscences of General Herman Haupt. Written by Himself, with Notes and a Personal Sketch by Frank Abiel Flower. Size 7 by 10 in. Pp. 331. Washington, 1901.

A most interesting volume of experiences in the engineering work during the Civil War, including hitherto unpublished official orders, personal narratives of important military operations, interviews with President Lincoln and members of his cabinet, and much valuable matter otherwise inaccessible. The history of the engineering work on the Hoosac Tunnel, and of other important civil engineering operations is given, the whole forming an account of engineering during and after the war at first hand by one who can say of it: "All of which I saw, and part of which I was."

*Marine Engineering.*

Practical Marine Engineering. For Marine Engineers and Students with Aids for Applicants for Marine Engineers Licenses. By William F. Durand. Professor of Marine Engineering at Cornell University. Size 6 in. by 9 in. Pp. 706. Price $5.00. New York: Marine Engineering Inc. 1902

A most complete working treatise on marine engineering, discussing not the design of marine engines, but rather the arrangement and operation, including not only the main engines, but also the auxiliaries, including electrical and refrigerating machinery. The operation of the machinery is explained in a clear and simple manner, and numerous examples are given in explanation of the computations which the working marine engineer may be called upon to make.

These computations and questions form an excellent preparation for examinations for licenses, having been prepared with that end in view. The book fills a void which has needed attention, and does it well.

*Boilers.*

Water-Tube Boilers. Based on a Short Course of Lectures delivered at University College, London. By Leslie S. Robertson. Size 5½ by 8½ in. Pp. 213. Price $3.00. New York: D. Van Nostrand Co. 1902.

A general and popular treatise on water-tube boilers for marine use, based largely on the author's translation of the larger work of M. Bertin. Numerous illustrations of the various designs of water-tube boilers are given, together with auxiliary apparatus, feed regulators, etc., also the interim report of the Admiralty Commission appointed to discuss the questions connected with the adoption of various types of boilers in the British Navy.

*Municipalities.*

Municipal Administration. By John A. Fairlie. Size 6 in. by 9 in. Pp. 448. Price $3.00. New York: The Macmillan Company. London: Macmillan & Co., Ltd., 1901.

A scholarly treatise on the various problems connected with municipal administration, including the history of municipal growth in Europe and in the United States; questions of health, safety, education, improvements and general administrative organization.

The present tendencies in the growth of cities are discussed in a manner free from partisanship or prejudice, and the work is an admirable example of the manner in which problems of such vital importance should be considered.

*Architecture.*

Architectural Engineering. With especial reference to High Building Con-

struction. By Joseph Kendall Freitag. Size 6 in. by 9 in. Pp. 407. Price $3.50. New York: John Wiley & Sons. London: Chapman & Hall. 1901.

An engineering study of the steel skeleton building, including not only the questions of strength and stability, but also the details of interior construction, finishing, fire proofing, drainage, etc. Numerous illustrations of typical tall buildings in American cities are given, including floor plans, showing arrangement of rooms, lighting, elevators, and all the engineering features involved in modern architecture of business buildings. The work is an excellent example of the manner in which engineering has entered into the fundamental work of the architectural profession.

*Iron.*

Cast Iron. A Record of Original Research. By William J. Keep. Size 6 in. by 9 in. Pp. 225. Price $2.50. New York: John Wiley & Son. London: Chapman & Hall, Ltd. 1902.

A complete account of the author's researches into the conditions accompanying the behaviour of cast iron in cooling, including the improved methods of testing cast iron, and the practical application in the foundry of the principles set forth. Numerous diagrams of test pieces, curves, etc., are given, and the work enables the whole of Mr. Keep's important researches to be studied together. The work is an important contribution to original knowledge concerning cast iron.

*Annual.*

Annuaire pour l'An 1902. Publié par le Bureau des Longitudes. Size 4 in. by 6 in. Price 1 franc 50 centimes. Paris: Gauthier Villars. 1902.

The current issue of the well-known annual, containing an abstract of the large almanac of the Bureau des Longitudes, together with much useful general scientific information by such specialists as: MM. Poincaré, Cornu, Guyou, and Janssen. Many valuable physical and general tables are given, the whole forming a most convenient book of reference for the year.

*Transmission.*

Power and Transmission. By E. W. Kerr. Size 6 in. by 9 in. Pp. 356. Price $2.00. New York: John Wiley & Sons. London: Chapman & Hall. 1902.

A text book upon the general design of machinery of transmission, including shafting, belting, levers, piping, etc. Also of power generation, including steam, gas, and water power, and compressed air. The work is prepared from the author's lectures as used at the University of Texas, and is well adapted for the presentation of the general principles of power generation and transmission to the student of mechanical engineering.

*Cast Iron.*

Metallurgy of Cast Iron. A Complete Exposition of the Processes involved in its Treatment, Chemically, and Physically, from the Blast Furnace through the Foundry to the Testing Machine. By Thomas D. West. Third Edition. Size 5 in. by 7 in. Pp. 627. Price $3.00. Cleveland, Ohio: The Cleveland Printing and Publishing Co. 1901.

A new edition of Mr. West's well-known book, containing much new matter based upon foundry practice in America and Europe. An excellent feature of this edition is the compilation of the tests of the American Foundrymen's Association, which are of especial value because they include tests upon a number of bars of different grades poured at the same temperature. The practical character of the work renders it especially valuable to owners and operators of foundries.

*Engineering.*

The Mechanics of Engineering. Volume I. Kinematics, Statics, Kinetics, Statics of Rigid Bodies, and of Elastic Solids. By A. Jay DuBois. Size 8 in. by 11 in. Pp. 634. Price $7.50. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. 1902.

A fundamental treatise upon the principles of mechanics, forming one of the Yale Bicentennial publications. The work forms a record of the present condition of the study of mechanics of engineering, and as such is a monumental contribution, not only to the state of the subject as taught at Yale University, but also of the position of Professor DuBois, as an expounder of the science of engineering.

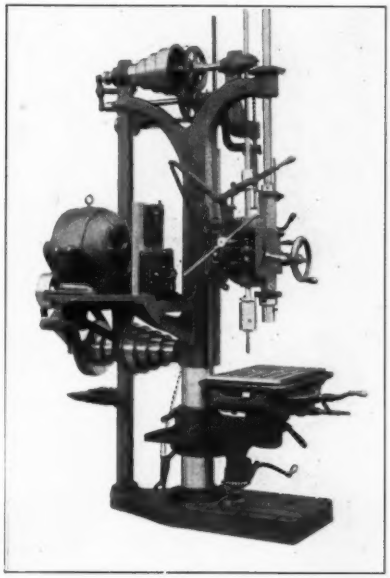
# IMPROVED MACHINERY

**New Processes and New Appliances**

*The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.*

### Upright Drill Press.

THE accompanying cut illustrates the latest improvements which have been made in the 25" upright power feed drill-presses made by Gould & Eberhardt, Newark, N. J. The illustration was made from one of a lot of machines which have just been shipped to the United States Government Printing Office, at Manila, P. I. The table and tablearm are now raised by bevel gear and screw, similar to all their larger sizes of drills, instead of by rack and pinion on column, as formerly employed on this size drill. As the gearing for raising and lowering the table is placed about central between the center of the column and the drill spindle, it equalizes all strains and weights brought to bear on the table.



The illustration furnishes a good view of the Eberhardt's patent automatic tapping attachments, shown on left of drill spindle proper. The attachment is used for tapping holes after they have been drilled, the work being rapidly moved across and centered under the tap by means of the oblong, compound traverse table. When one hole is completed it is ready for the next.

The method of arranging direct-connected electric motor, is also shown. The bracket which supports the motor is bolted to the upright columns of the drill, and belted direct from armature shaft to driving pulley, and the switch for the motor has been placed where it can be quickly and conveniently reached by the operator.

An automatic stop and depth gauge throws out the feed after drill has reached the required depth. The back gears are arranged so that one movement of a lever releases the cone from the shaft and engages the gearing, and changes the feed ten times coarser, while one movement in the opposite direction disengages the gearing. The spindle is provided with means for compensating all wear which may take place in the quill, by means of a double conical bearing. The spindle head is vertically adjustable and can be raised or lowered and clamped in position. A square quill is used in place of the usual round sliding barrel. This adds greatly to the rigidity of the spindle in boring deep and rough holes, as it has more clamping surface and the barrel

is less liable to gain play in the head. T slots run out to the edge of the table and base, so that work can be bolted very close to the edge, as is very often necessary. The slots are of such a size that standard square headed bolts will fit at once, without having special ones forged.

It is the only drill press we know of which can at will be made to feed either automatically or by hand, up or down, separately through the head the entire length of planed surface on column, or independently through the rack on quill. All changes are made from the front of machine, thus allowing the operator to remain in one position, directly before his work. It is a rigid, accurate and substantial drill, and with proper care will last a lifetime.

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### Incandescent Lamp Efficiency.

MR. FRANCIS W. WILLCOX read a a paper before the National Electric Light Association on the distribution of light vertically and horizontally from the standard incandescent lamp filaments. He illustrated his experiments by means of polar diagrams, showing the distribution from several common forms of lamp filaments. The conclusion is that the distribution is much greater in the horizontal than in the vertical plane, the common single loop or hairpin filament giving the best distribution horizontally. This defect, of course, has long been recognized, as shown by the numerous forms of filaments devised with a view to distributing the light more symmetrically. We reproduce herewith some of the diagrams showing the results obtained with several forms of filaments.

In Fig. 1 is shown the vertical and horizontal distribution from the single loop filament at intervals of 45 degrees. Full candle power is obtained, it will be observed, in six or eight radial directions from the axis of the lamp, while the vertical distribution falls to less than a third of the light given out horizontally. Fig. 2 shows the single coil filament, which gives a slightly better distribution straight downward from the bulb, although the distribution horizontally is more unstable than that from the single loop, the candle power ranging from 12 to maximum. Practically the same vertical distribution is obtained from the double loop, while the distribution horizontally is much more satisfactory, ranging from 15 to 17 candle power in a

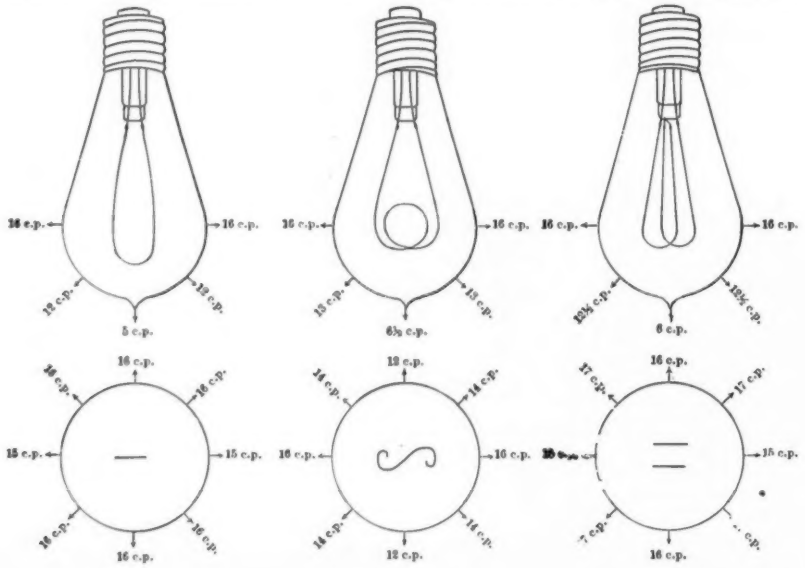



FIG. 1. FIG. 2. FIG. 3.

16-c. p. lamp. Figures 4 and 5 are self explanatory, it being observed that Fig. 4, known as the oval anchored filament, gives the best all-round distribution.

A new form of filament designed to accomplish still better distribution of light is shown in diagram 6, while the accompanying half-tone furnished by the Sterling Electrical Manufacturing Company, Warren, Ohio, gives a general view of the lamp itself. It will be observed that this form of filament shows a perfect balance in both the vertical and horizontal planes, the full 16-c. p. being obtained at all angles. The manufacturers state that the efficiencies here given were actually obtained by photometric measurements with a stationary lamp. These lamps are manufactured in the usual candle powers and voltages and are supplied with stationary bases.

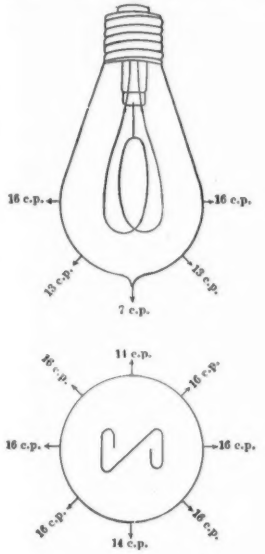



FIG. 4. FIG. 5. FIG. 6.

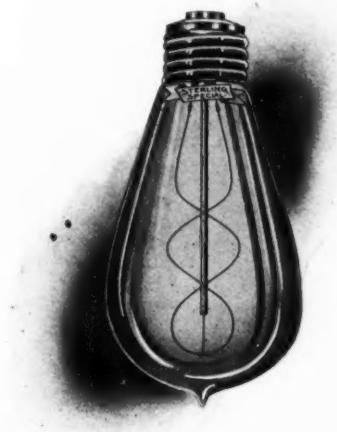


FIG. 7.

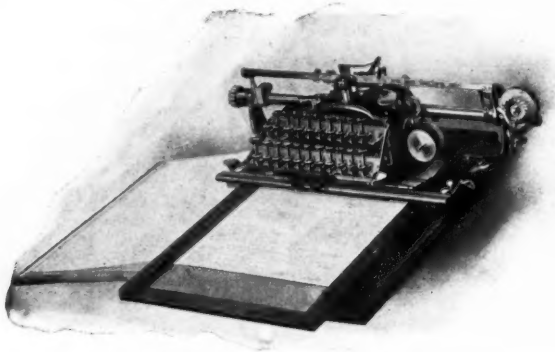
## Book Typewriter.

HERETOFORE mechanical writing has been confined to loose sheets of paper. By means of the Elliott & Hatch book typewriter bound books of every description, regardless of dimensions, may be written in, and it will write upon single sheets of paper equally as well as the standard typewriter. It is a perfect substitute for the pen, making every entry that can be made with pen and ink.

The writing is in clean, clear-cut type.

The speed is more than twice as fast as that of the pen. Its use saves the time of the writer as well as that of the reader.

In the machine the surface upon which the paper or leaf of the book lies is perfectly flat and stationary. A very simple device adjusts the single sheet of paper or the thickest book, no matter at what point it may be opened. The writing mechanism moves over the surface. The operator has complete control of the writing point, and can guide it over the writing surface as easily as the pen.



It can be used on any book, no special size being required. The typewriter is made in nine sizes, sufficient to accommodate all requirements. Single sheets of paper may also be used. The fact that the type bars strike downward on a solid flat surface produces the best manifolding machine manufactured, since it is possible to make fifteen to twenty copies without increasing the force with which the key is usually struck.

Another commendable feature is that a dozen or more envelopes may be placed on the machine at one time, or cards of any dimensions or thickness may be written upon. The machine will write to the extreme top or bottom of a card of any thickness.

The type bar of the Elliott & Hatch Book Typewriter is one-third shorter than that of any other, the key stroke is therefore shorter, and much higher speed is attainable. It is, in fact, capable of greater speed with less effort than any of the standard typewriters. The depression of the shift key is less than one-half that on any other machine, and therefore much quicker in action. Marginal stops are so arranged as to enable the operator to adjust the line to the desired length, and the bell-ringing mechanism is automatic. The tabulator admits of any number of columns being written. The carriage shifts to the desired column automatically. All machines are equipped with the tabulating attachment.

For railroad and insurance companies it is almost indispensable since the equipment of the tabulating attachment is a great time saver in the preparation of manifests. The same is true in post and all public offices, or, in fact, any establishment where it is necessary to compile many statements and reports.

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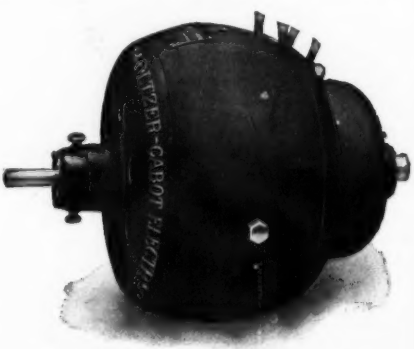
### Launch Motors.

NAVIGATION is one of the latest fields to be invaded by electricity, and now small launches and even row boats are being driven by electric motors in an entirely



satisfactory manner. In the accompanying illustration is shown a half horse power motor, which is one of a line constructed especially for launch work. As will be observed, the motor is entirely enclosed, being practically moisture proof. If the motor is well protected or is to be used in fresh water, the weight is materially decreased by the use of aluminum in parts where other metals are not necessary for electrical or magnetic purposes. If the motor is likely to be exposed to the salt water, brass or iron fittings are recommended because of the corrosive action of the salt water upon the aluminum. It is very compact in design.

As the voltage is low the current is necessarily proportionately high, making the design of the brush holder a feature of great importance. The brush holder used with these motors is of the box type with parallel feed, making it possible to run the motor for a long period of time without any attention to the brushes.

The machines are very economical in operation. The speed is low, 1,000 R. P. M., and as they are series wound, they use field energy only in uproportion to the load, thus modifying two of the most important sources of waste, namely, friction and heat losses in the windings. This line of machines is being manufactured by The Holtzer-Cabot Electric Co. of Boston, Mass.

### The Use of Limit Gauges.

IN discussing the important paper of Mr. H. F. L. Orcutt on modern machine methods, reviewed at length elsewhere in this issue, Col. R. E. Crompton emphasised the value and importance of the use of limit gauges.

A works might have ordinary gauges, but they were not sufficient. No doubt an outfit of limit-gauges was expensive, but single gauges could not be trusted, and the use of the limit-gauge was the only way by which the elimination of the fitter could be secured. By the aid of these appliances work could be finished off the machine and put together by unskilled hands—that was to say, by persons not skilled in the use of cutting-tools. He had tried to introduce the system, but had found great trouble arose in doing so. He now understood why this was, as experience showed that a large and well-organised viewing department, including a competent staff of foremen, underforemen, and assistants, was necessary for success. Example might be taken from some of the large Birmingham shops; and he would point out that though Birmingham once had a reputation of producing work the reverse of accurate, that had all been changed, and in no place was better work turned out, in regard to going together without fitting, than it now was in Birmingham. Speaking of the tool-room, Colonel Crompton said he could not understand how any important works could do without a tool-room, but he did not think its proper function was to make tools, but to keep them in order. The only things that should be made in a tool-room of the works were jigs and templates special to the work being produced. If the attempt were made to produce milling cutters, reamers, and other tools of that nature, the attention of the tool-room staff would be diverted from their proper functions, and not such good tools would be produced as could be bought. The author was right in what he said about portable machines. He had stated that they were not new, but had recently been extensively developed in large engine works, and in the manufacture of electric motors and generators.

### Schmidt Direct-Fired Superheater.

IT has been demonstrated that the advantages to be derived from the superheating system are very great, and, along the same line, it is an established fact that the higher the superheating the greater the gain insomuch that the loss by cylinder condensation is practically nil. For many years serious difficulties presented themselves in the practical application of superheating. These difficulties arose partly in the superheater and partly in the engine. With the former, if too high temperature was obtained the tubes were very liable to be burnt out. On the other hand were the tubes properly protected, the utilization of the heat of the gases was restricted.

The troubles with the engines were principally due to their construction being unsuitable for such high temperatures, and also to some extent to the difficulty of effecting proper lubrication, thus causing excessive wear and tear and increased cost of maintenance.

Mr. Schmidt's system has practically done away with these difficulties, and his engines and boilers require no more care nor attention than ordinary engines and boilers, while at the same time the results as regards economy in their operation are extraordinary.

In his superheater combines the advantages of both *counter current* and *concurrent* systems while avoiding their drawbacks. The saturated steam enters through the valve at the top, and therefore utilizes the advantage of the counter current system, namely, high efficiency. The steam, having been merely dried in the upper half of the apparatus, is led through the passages to the bottom tubes cooling them from the inside and so protecting them from deterioration. It then flows on the concurrent system in the same direction as the flue gases, taking up heat from them on the way. The higher the temperature of the steam the less that of the gases, and the steam leaves the superheater when it is at its hottest. The gases leave the superheating coils at about 1,000 degrees Fahrenheit and pass on to the drying soils, whence they enter the main flue at a temperature of about 460 degrees Fahrenheit.

The advantages of this system can easily be seen. The system is owned by Easton & Co. (Ltd.), Erith and London. The American rights are controlled by the Providence Engineering Works of Providence, R. I.

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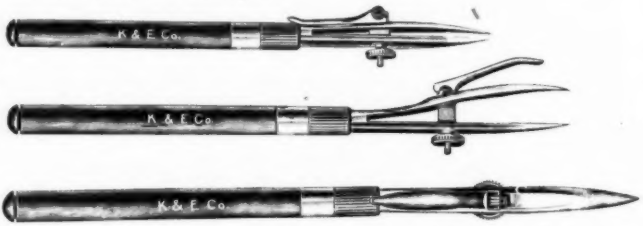
### The Patent Paragon Drawing Pen.

THE patent Paragon drawing pen possesses all the excellent qualities which have made Paragon pens famous. In addition it has the advantage that it can be instantly opened for cleaning and closed again, without altering its original setting.

The blades are widely separated by the spring in the upper blade, when the excenter on the angular shank of the adjusting screw is released. On reapplying it the blades are brought to exactly their original position, smoothly and without jar.

The adjusting screw is on the lower blade, permitting of changing the adjustment by applying one finger of the hand holding the pen.




The pen is an entirely new instrument, having only been patented last October. In practical use it has proven its efficiency as an instrument far ahead of the former old style pens.

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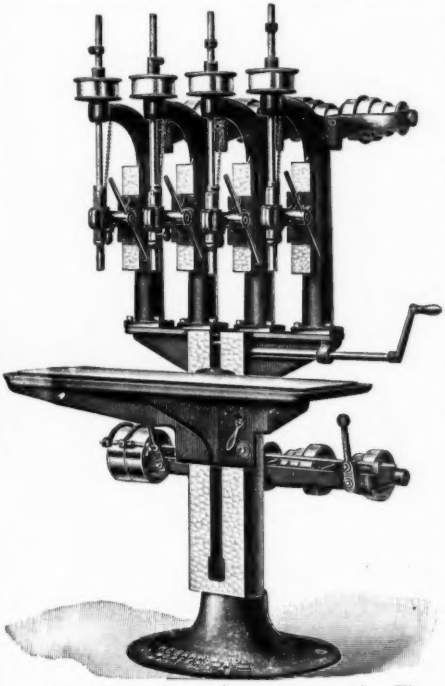
### Drop Forged Wrench.

EVEN in this day when ultraseriousness to a greater or less degree enters into all phases of the business world, there is time for slight relaxation from the usual rigidity of the conduct of business. The accompanying cut shows by contrast with the size of a workman, the largest drop forged wrench in the world, manufactured by J. H. Williams & Co., of Brooklyn, N. Y. It weighs 150 lbs., is 59 inches long; the opening is 7⅝ inches, made for use on 5 inch bolts. As an extreme contrast the firm manufactures what is known as No. 00 wrench of the same design which weighs but ½ ounce. The large wrench is "master" of a line of 15 degree-angle design tools, which was first put out by Mr. Williams 17 years ago. The firm explains that

the wrench is most used on the nuts for foundation bolts, journal boxes and bolts of flywheel sections.

### Upright Spindle Drills.

ONE of the finest types of the 2, 3, 4, and 6 spindle upright spindle drilling machines is manufactured by H. G. Barr & Co., of Worcester, Mass. These drills are recommended for work of any kind from holes of 1/32 inch to 9/16 inch. The machine has the advantage of being able to



turn out good work at any speed. The highest spindle speed is about the speed of the driving shaft. The slowest speed of the spindle is one-third that at which the driving shaft is speeded.

The gears are all fully warranted. The columns are braced on the inside and are very rigid. All the tables are raised with a screw and all the sliding surfaces are scraped to test and fitted. Every tool that is put out is fully warranted to be perfectly accurate.

The company is able to offer to the trade a special gear with which it is possible to secure more power. They have a special six-spindle drill, the net weight of which is 1,450 lbs. Sixteen styles are always carried in stock and where a machine cannot be furnished according to specifications from the stock, it is made to order.

### Industrial Notes.

—Charles W. Ten Broeck has been appointed industrial agent of the Lackawanna Railroad, to succeed William B. Hunter, who has resigned to engage in other business. Mr. Ten Broeck has been for more than two years division freight agent of the Lackawanna at Scranton. He will assume his new duties on March 1st, making his headquarters in the general offices of the company in New York city. His particular work will be to encourage and promote the location and development of industries upon the Lackawanna Railroad.

—The Cataract Power and Conduit Company of Niagara Falls has recently awarded to the Westinghouse Electric & Manufacturing Co. a contract for seven 2500 H. P., oil-insulated, water-cooled transformers. These transformers will be wound for 2,200 volts, 2-phase to 11,000 or 22,000 volts, 3-phase, and will duplicate the present equipment in the Transformer House at Niagara Falls.

—The Stilwell-Bierce & Smith-Vaile Company, of Dayton, O., has secured an order through W. H. Crossman & Bro., of 77-79 Broad street, calling for a 1,000 horsepower outfit of turbine water wheels, which is intended to be installed in an electrical plant at Santos, Brazil.

—The Riter-Conley Manufacturing Co., of Pittsburg, is reported to have recently secured contracts calling for the shipment of 30 steel tanks for use on a sugar plantation in San Salvador, and two petroleum tanks for the Hawaiian Islands. The value of these contracts is said to be about $60,000.

—The Atlantic Gulf and Pacific Company has just secured the contract valued at $550,000 for the construction of the Sangley Point coaling station at Cavite, Philippine Islands. The contract calls for two steel coal sheds measuring 145 feet by 193 feet, one steel wharf 75 feet by 410 feet, one steel coal bunker 30 feet by 360 feet, two traveling coal hoist towers each of 50 tons capacity per hour, 12 automatic elevated coal rail-

ways, 1½ miles of coal railway, with cars, tubs, floor valves, etc., 50,000-gallon gravity water storage system, power and pump house for 200 horse-power, etc. About 3,400 tons of steel and iron will be required, the bulk of which will be supplied by the American Bridge Company. The coal towers and the 1½ miles of coal railway, etc., are to be furnished by the C. W. Hunt Coal Machinery Co. The material, etc., is to be shipped, chiefly from New York, inside of six months. The Atlantic concern, it will be recalled, has also undertaken the $1,950,000 contract for the Manila harbor improvements, for which considerable quantities of American machinery, etc., will be used.

—The Philadelphia Pneumatic Tool Company has let the contracts for their new building, which will be erected on Twenty-first street below Alleghany avenue in Philadelphia, Pa. The shop will be but one story in height with a floor space of 96x130 feet with a side extension for a boiler house of 24x44 feet. The engine room will be located in the basement, and an 80 H. P. together with a direct connected generator for lighting will be installed. The boiler will be 60 x 16 feet of the return tubular type. The company expects to move into their new quarters not later than May 1st. A large number of machine tools, brand new, are being installed daily. The shop will be fully equipped with a steam heating plant, modern sanitary arrangement, lockers for the men, and in fact everything to make it a complete modern shop in every particular.

—The New Process Raw Hide Company, Syracuse, N. Y., reports business as very good at the opening of the new year. The company is in receipt of an order from the British Westinghouse Electric & Manufacturing Co. for 60 of its New Process Noiseless pinions for the equipment of the British Company's new plant. These pinions are to be used on motors for driving machine tools, electric cranes, etc., and are for transmitting from 5 to 40 H. P. Orders from other sources are coming in fast and the outlook is promising for a good business year.

—The Joseph Dixon Crucible Co., Jersey City, N. J., give interesting information concerning the protective painting of the Union Railroad Bridge, which crosses the Monongahela River at Pittsburg, (Rankin), Pa. The associate engineers were Messrs. Emil Swensson, designer and engineer of construction, and Wm. H. Smith, chief engineer, Carnegie Steel Co. The total weight of this bridge is 5,135 tons, and it has a total length of 2,328 feet. Designed for carrying molten metal from the Carrie furnace to the steel mill and raw materials to the furnaces, this notable steel structure is subjected to heat from the molten metal, sulphur fumes from locomotives and river steamers, also from the adjoining furnaces and steel mills. No other steel bridge in all the world is exposed to so many and severe destructive agencies. The best metal preservative was necessary, and the eminent engineers selected for its protection Dixon's Silica-Graphite Paint, as manufactured by the Joseph Dixon Crucible Company.

—The aggressive and progressive spirit of the times has again been shown by the able management of the Chicago Pneumatic Tool Co., in the recent consolidation of their various large interests at home and abroad, and the acquisition of two additional up-to-date plants, viz: The Chisholm & Moore Manufacturing Co., (Pneumatic Cranes and Hoists), and the New York-Franklin Air Compressor Co., (Air Compressors). The crane department is running full time on orders in hand, and from the number of inquiries received since January 1st, the outlook is, this plant will shortly be working double shift. The compressor department have ample orders to keep a full complement of workmen employed for some time to come.

—The York Manufacturing Co., of York, Pa., have just shipped a 500 ton refrigerating machine to the Anglo-American Packing Co. of Chicago. This is the largest single acting machine that has ever been constructed, with the exception of a similar one, built by the same company some years ago, for the Armour Packing Co. of Kansas City, Mo.

—Mr. Reuben C. Hallett, who has a large circle of friends throughout the country, has accepted a position with the Chicago Pneumatic Tool Company's Eastern Sales Department.

—J. A. Fay & Egan Co., of Cincinnati, Ohio, manufacturers of standard wood working machinery, have just opened a new branch office at 69 Chapin Block, Buffalo,

N. Y., in charge of Mr. B. E. Crafts, who will at once enter into active business operations to further the interests of the company. Mr. Crafts has heretofore represented the firm as salesman for that territory, but the continually increasing business of the company necessitated this new move, which will better enable them to cater to the wants of the users of wood working machinery.

—Charles L. Duenkel, B. S., M. E., an engineer of experience, has opened an office at 120 Liberty street. Mr. Duenkel has had fifteen years' practical experience in the design and construction of inclined railways. He makes a specialty of inclined railways, low and high pressure hydraulic machinery, and safety elevator air-cushions.

—We are informed that The Ball Bearing Co., Boston, Mass., well known as manufacturers of ball and roller bearing for all kinds of machine construction, have moved their factory to Philadelphia, where they will enjoy exceptional facilities for handling their large and increasing business in the most expeditious and convenient manner.

—The Sprague Electric Company has closed an order with the Atlas Portland Cement Company for three 400 K. W. engine type split pole generators at speed of 156 r. p. m., for their plant in Hannibal, Mo. Another order is from the De Laval Steam Turbine Company for ten 20 K. W. and ten 75 K. W. turbine generators. The Pennsylvania Steel Company have ordered for their new bridge shop at Steelton, Pa., fifteen wall crane trolley hoists, the electric hoisting equipment of which is built by the Sprague Company.

—To thread a pipe, of which but one end is exposed, at the bottom of a trench, has ceased to be a hard job since the introduction of Forbes' die stock by the Curtis & Curtis Co., of Bridgeport, Conn. This machine is so powerful that one man operating it can cut off and thread twelve inch pipe. It is so light that it can be carried about like any other tool, and so compact that it can be used even in the most confined places. The dies can be sharpened on the grindstones without first drawing the temper. The shell can be adjusted to take up the wear of gear. For heavy work, the Curtis & Curtis Co. make power cutting and threading machines, in which the vice for holding the pipe is self-centering and the dies may be adjusted to any variation of the fittings.

—Following a recent custom introduced within the past few years by various large manufacturing concerns of England, the Jessop Steel Co. has bought a site and will erect a large plant for the manufacture of crucible steel at Washington, Pa. The company is capitalized at $250,000 under the laws of Pennsylvania. Sidney J. Robinson, managing director of the Wm. Jessop & Sons, the old established firm in England, sailed for London last month after completing all arrangements for the new plant.

—The Alberger Condenser Company of 95 Liberty street, New York, has been awarded the contract for the condensing apparatus for the central power station of the Rapid Transit Subway Railroad. This apparatus will consist of eight units of 10,000 H. P. each, or a total of 80,000 H. P., and is the largest condenser equipment ever undertaken in any part of the world. The type of machine selected for this important service is known as the "barometric" condenser, recently brought out by the Alberger Company. The water pumps and the vacuum pumps used in this apparatus are separate crank and flywheel machines and are to operate in a vertical position.

—Clarence P. Day has undertaken a unique service for mechanical advertisers. Mr. Day has acquired an intimate knowledge of the engineering and technical press and advertising in it by an experience of eighteen years in the preparation and placing of advertising for manufacturers. He is now prepared to advise and assist those advertisers of machinery who wish to place their business to the best advantage. Not being influenced by commissions or private understandings between himself and the publisher, there is no incentive to recommend mediums or place advertising in a way to produce the greatest personal return rather than the greatest benefit to the advertiser. Mr. Day is in no sense of the word an advertising agent, rendering his services to the advertiser only and receiving compensation only from him.

—Pawling & Harnischfeger, Milwaukee, Wis., makers of electric cranes, advise that

business conditions are satisfactory, and more than usually so in the volume of orders. To secure a very large order is gratifying, but this firm has obtained, as far as we know, the largest order ever placed by one company at one time for electric cranes. This lately was placed by Allis-Chalmers Co., Edw. P. Allis Works, Milwaukee, Wis., for the new factory buildings at West Allis, and specifies thirty-five cranes ranging in capacity from 5 to 75 tons. The demand for electric cranes in these immense and modern shops will be well taken care of through this order. In addition to this order, Pawling & Harnischfeger have recently booked orders for forty-three electric cranes from other well known firms, among which are the following: La Belle Iron Works, Steubenville, O., one 10 ton; the Glamorgan Pipe & Foundry Co., Lynchburg, Va., one 15 ton; Wheeling Steel & Iron Co., Wheeling, W. Va., one 7 ton; and a number of others ranging in size from two to 14 tons.

—The Southern Pacific Railway Company has decided to improve its facilities at various points on its system for the building and repairing of rolling stock; and to this end have placed with the American Bridge Company of New York contract for boiler shop at East Portland, Ore.; boiler and machine shops at San Francisco, Cal.; boiler and machine shops at Los Angeles, Cal.; machine shop at El Paso, Texas; machine shop at Houston, Texas. These buildings are all about 120′ x 250′, equipped with traveling cranes.

—After the almost total destruction of their large works in Brooklyn, N. Y., by fire last July, the Abendroth & Root Mfg. Co., 99 John street, New York City, have resumed the manufacture of their well known Spiral Riveted Pipe and Water Tube Boilers with new works at Newburgh, N. Y., having purchased the recently built plant of the Wright Steam Engine Works. In the new shop the company have an equipment which will enable them to improve their products to the highest degree, with a great increase in capacity. The Newburgh works is a model plant and covers twelve acres of land, with a frontage of 823 feet on the Hudson River and a private dock extending out to deep water.

## NEW CATALOGUES AND TRADE PUBLICATIONS

*These catalogues may be had free of charge on application to the firm issuing them. Please mention The Engineering Magazine when you write.*

***Air Compressor.***

Small, attractively printed booklet, with illustration of the Blanchard Air Compressor. Dust proof, oiled automatically by the splash system. Full description of the machine parts. Concise. The Blanchard Machine Co., Boston, Mass.

***Bale Ties, Wire.***

Compact pamphlet and list card giving sizes, weight and complete price-lists of patent steel wire bale ties; also shows styles of catches. Griswold Wire Co., Braddock, Pa.

***Boiler, Water-Tube.***

Small attractive booklet descriptive of the Taylor water-tube boiler, with table showing capacity of smaller sizes. A marked departure from general form of water-tube boilers. Taylor-Water-Tube Boiler Co., Detroit, Mich.

***Bolts and Nuts.***

Handsomely illustrated catalogue on refined merchant bar iron, bolts, nuts, washers, rivets, screws, arch bars, body bolsters, and other car forgings. Index, telegraphic code. American Iron & Steel Manufacturing Co., Lebanon, Pa.

***Calipers.***

Neat booklet entitled "Columbia Calipers" describing a number of tools. Thorough discussion of the utility of the sliding or graduated beam caliper. E. G. Smith, Columbia, Pa.

***Car Loader.***

Well illustrated booklet showing the "Ottumwa" box car loader in use at coal mines. Full description of the machine. Ottumwa Box Car Loader Co., Ottumwa, Iowa.

***Carriage Hardware.***

Illustrated catalogue of a very complete line of carriage hardware, fifth wheels, and naked axle forgings. Tables of sizes and prices. D. Wilcox Mfg. Co., Mechanicsburg, Pa.

### *Compressors.*

Catalogue No. 46, fifth edition, full tables and telegraphic code, giving full page illustration and description of the development of the Riedler compressors. Tables of capacity. A very handsome publication. Allis-Chalmers Co., Chicago, Ill.

### *Concentrator.*

Illustrated booklet showing the advantages of the "New Standard" concentrator in mining. Tables of capacity. P. B. McCabe & Co., 602 North Main St., Los Angeles, Cal.

### *Cranes, Electric Traveling.*

Very attractively printed catalogue, sixth edition, 1901, profusely illustrated, showing the cranes in parts with full description, and many full page illustrations of the machines in actual use. Code and list of patrons. Pawling & Harnischfeger, Milwaukee, Wis.

### *Drilling, Machines.*

Attractive catalogue, fully illustrated, showing the Cincinnati upright drilling machine in all standard sizes. Full specifications and code. Cincinnati Machine Tool Co., Cincinnati, Ohio.

### *Drop Hammers.*

Catalogue for 1902, well printed and illustrated, treating improved drop hammers, trimming presses and heating furnaces. Table of size, and prices. Billings & Spencer Co., Hartford, Conn.

### *Dry Kilns.*

Catalogue No. 114; fully illustrated, demonstrating the claimed essential advantage derived in the use of the Sturtevant dry kilns. Typical applications of the Sturtevant apparatus. B. F. Sturtevant Co., Boston, Mass.

### *Dump Car.*

A most handsome catalogue of 60 pages, 12 by 17 inches, in half roan and linen, illustrating the Goodwin patents, covering cars, vessels, bins, barges, trucks, chutes and the like. This book is replete with detailed drawings of the apparatus and is illustrated with excellent full page photographs showing Goodwin cars and their many uses. As an example of modern catalogue making, it stands very high. The principal advantages claimed for the Goodwin car are: Greater saving in cost and time of transporting and unloading; greater durability than any wooden or other steel car; it is the only car from which one man, while the train is in motion, can discharge the entire train load of large or fine material, at the same instant depositing the load either between the rails, or outside, or both at the same time.

### *Electrical Supplies.*

General catalogue of electric light supplies, general house goods and street railway supplies. Profusely illustrated and very extensive in scope. Western Electric Co., Chicago, Ill.

### *Emery Wheels.*

Well printed and illustrated catalogue, showing the apparent advantage of the emery grinding machine over the old system of filing. Tanite Co., Stroudsburg, Pa.

### *Engines, Oil.*

Fully illustrated, attractively arranged catalogue, showing the "Hornsby-Akroyd" patent safety oil engine. De La Vergne Refrigerating Machine Co., foot of East 138th St., New York, N. Y.

### *Expansion Bolts.*

Illustrated catalogue of "Evans" improved patent expansion bolts for use in fire-proof buildings, bridge work, engine beds, marble work, fire escapes, etc. F. H. Evans, 596 Kent Ave., Brooklyn, N. Y.

### *Feed Pump.*

Special circular, illustrated, with complete price list, size, capacity, telegraphic code and extras of the "Ohio" automatic feed pump and receiver. Ohio Steam Pump Co., Canton, Ohio.

### *Feed Water Heaters.*

Handsomely illustrated catalogue setting forth the advantages of the Keller feed water heater, purifier, condenser, and hot air blast device combined. Much saving claimed in fuel and water. National Steam Economizer Co., Springfield, Mass.

### *Foundry Supplies.*

Handsomely bound catalogue with illustrations and descriptions of all manner of foundry supplies; also, special catalogues of supplies and equipment for the complete installation of brass, bronze and aluminum foundries; special catalogue of ladles; booklet treating the Hammer core machine, and small folder on the "Boston" foundry mixer. S. Obermayer Co., Cincinnati, Ohio.

### *Freight Cars.*

Very handsome and attractive catalogue, profusely illustrated, showing a number of types of cars constructed by this company. M. H. Treadwell & Co., 95 Liberty St., New York, N. Y.

### *Furniture, Machine Shop.*

Small, interesting booklet, illustrated, containing sizes and prices of tool racks, lathe pans, shelving and other articles of machine shop furniture in iron and steel. New Britain Machine Co., New Britain, Conn.

### *Gloves.*

Attractive booklet, fully illustrated, with descriptions of many styles of gloves, handmade of finest material, warranted to stand water or heat. Specialty in gloves for mechanical, civil and mining engineers. Prices given. J. P. Luther Glove Co., Berlin, Wis.

### *Hammer, Electric.*

Folder descriptive of the Jackson portable electric hammer, setting forth advantages over the pneumatic hammer. Jackson Co., 1610-14 Blake St., Denver, Col.

### *Lathes, Heavy.*

Large, handsome catalogue of heavy and powerful engine lathes, ranging in size from 28-in. to 84-in., with full page illustrations and description; also illustration of four-tool shafting attachment. Pond Machine Tool Co., 136 Liberty St., New York, N. Y.

### *Machinery Supplies.*

Tool Catalogue No. 9. Concise, fully illustrated, indexed, showing all kinds of mine, manufacturers', machinists', engineers', and platers' supplies, with description and tables of size and prices. Scott Supply and Tool Co., 1513-19 17th St., Denver, Col.

### *Machine Tools.*

Catalogue for 1902, exceptionally complete; indexed and full telegraphic code; illustrated. Contains thorough description with speed tables of all types of light milling machines. Replete with information of exceptional value to foremen and works managers, Brown & Sharpe Mfg. Co., Providence, R. I.

### *Meter, Electric.*

Well printed and handsome catalogue, illustrated, showing the Gutmann Watt meters for alternating currents. Full description of the meter, also report of tests. Saugamo Electric Co., Springfield, Ill.

### *Mining Machinery.*

Series of illustrated catalogues on hydraulic mining machinery; the Bartlett concentrating table; "Dodge" and "Giant" rocker breakers; mine and mill supplies; Roger's improved crushing rolls; gold mills, including machinery for the systematic treatment of ores. The Ropp straight-line furnace; Huntington centrifugal roller quartz mill; and hoisting, pumping and crushing machinery and supplies for mine prospecting and development. Parke & Lacy Co., San Francisco, Cal.

### *Motor Cycles.*

Small, attractive booklet, illustrated, demonstrating the perfect motor cycle, with price list of machines in parts or complete. Jos. H. Ferodowill & Co., St. Paul, Minn.

### *Power Hoist.*

Descriptive catalogue of the Harris patent power hoist and carrying machine. Full page illustrations of the machine in actual use. C. S. Harris Co., Rome, N. Y.

### *Pressure Regulator.*

Handsome, fully illustrated catalogue, giving sectional view, of the Foster pressure regulator for back pressure valves, engines, pumps, fans, etc. Complete telegraphic code. Foster Engineering Co., Newark, N. J.

### *Pumping Machinery.*

Small illustrated catalogue, full of interesting information on the general subject, claiming advantages to be derived from the use of a Luitwieler pump. Luitwieler Co., 405-7 North Main St., Los Angeles, Cal.

### *Pumping Machinery, Centrifugal.*

Handsome catalogue, replete with descriptive matter and tables of general information. Fully illustrated, and with telegraphic code. R. D. Wood & Co., Philadelphia, Pa.

### *Pumps.*

Catalogue No. 24, seventh edition, with code. Full page illustrations, demonstrating the many types of the Riedler pumps for mine drainage, irrigation, sewage, city water works, and hydraulic power plants. Replete with useful information, especially regarding irrigating systems. Allis-Chalmers Co., Chicago, Ill.

### *Rock Drills, Electric.*

Catalogue B., an illustrated treatise on rock drilling by electric percussion drills. Marvin Electric Drill Co., Canastota, N. Y.

### *Screw-Threading Lathe.*

Small well printed and illustrated pamphlet, discussing thoroughly the working of the automatic screw threading lathe. This machine combines the accuracy of the engine-lathe and the screw-machine. A labor saving and cost reducing machine. Testimonials of its precision and speed in actual use. Automatic Machine Co., Bridgeport, Conn.

### *Steam Specialties.*

Attractive booklet, well illustrated, on the general subject of steam specialties. Tables of capacity and prices. Pittsburg Gage & Supply Co., Pittsburg, Pa.

Very attractive, each appliance fully illustrated, with explanatory matter. Booklet also contains tables of sizes and capacity. Charles H. Paine, Singer Bldg., New York, N. Y.

### *Thermometers.*

Series of catalogues, all illustrated, Part I. treating thermometers and gauges for steam and power plants; Part 3 treating thermometers, hydrometers, and hygrometers specially adapted to cold storage, refrigeration and ice manufacturing; Part 4, of thermometers for brewing, beer bottling, distilling and malting; Part 5, of thermometers, hydrometers, and gauges specially adapted to canning, packing, fruit and vegetable preserving and meat packing. Also pamphlet on thermometers and thermo-steam gauges, especially constructed and adapted for sugar making and refining. Hohmann & Maurer Mfg. Co., 32 Elizabeth St., Rochester, N. Y.

### *Time Recorder.*

Attractively illustrated catalogue demonstrating the advantages of a time recorder in industrial works employing a large number of men. Simplex Time Recorder Co., Gardner, Mass.

### *Tool Holders.*

Small catalogue and illustrated price list, treating new and important addition to the common styles of tool holders; also full list of boring tools. Armstrong Bros. Tool Co., 617-21 Austin Ave., Chicago, Ill.

### *Union and Flange.*

Attractive pamphlet and folder, full description of the Jefferson union and flange, with complete price list. New device with bronze metal seat encased in malleable iron, ball joint shoulder. No packing used; for oil, steam, water, gas and air. Jefferson Mfg. Co., 186 Devonshire St., Boston, Mass.

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# THE ENGINEERING MAGAZINE

## AN INDUSTRIAL REVIEW

EDITED BY JOHN R. DUNLAP
CHARLES B. GOING, AND HENRY HARRISON SUPLEE.

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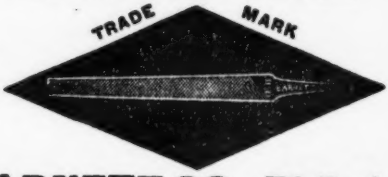


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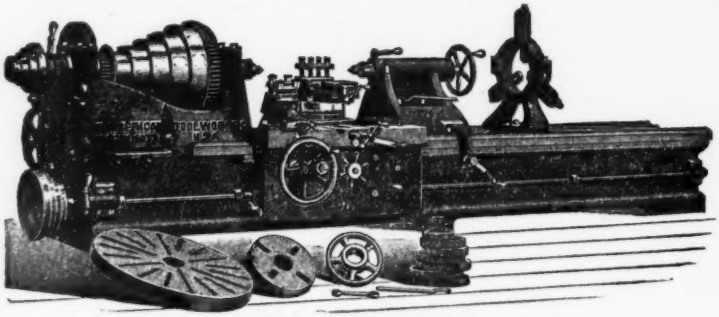

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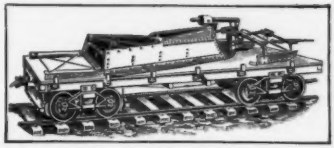

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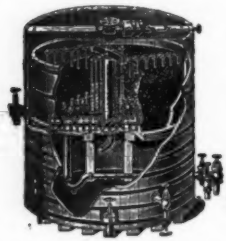

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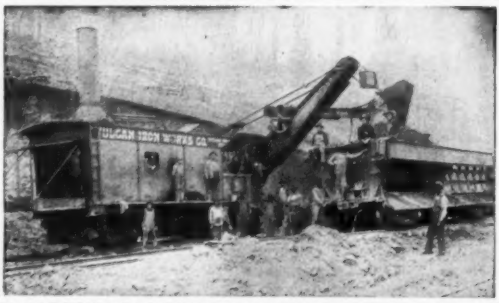

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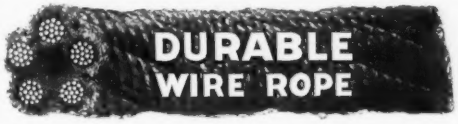
## AUTHORS AND PAPERS FOR MARCH, 1902.

GEORGE H. HULL *(The Mischievous Fallacy of Over-Production)*—Born in Dansville, N. Y.; has been identified with the pig iron business of the West and South for more than thirty years. During this time he has originated and inaugurated in the West many improvements and economies in the mode of handling this commodity, among which were: the introduction of agents' contracts for shipment direct from producer to consumer in lieu of the old and expensive method; the introduction of the pig iron "sale memorandum," which form is now universally in use; the establishment in connection with the Louisville & Nashville Railroad Co. of the "in transit" storage yards, which had made Louisville for many years the largest storage point for pig iron in the United States; the adoption of the sliding scale freight rates on pig iron by the northern roads, which he advocated until he was authorized by the Louisville & Nashville Railroad Co. to issue a call for the joint meetings between furnacemen and freight agents at Chattanooga and Nashville, which resulted in the adoption of that system. He is the originator and president of the American Pig Iron Storage Warrant Company, a company which was organized to provide for iron producers the facilities that the elevators and pipe lines have provided for the producers of grain and oil.

CHARLES U. CARPENTER *(Money-Making Management for Workshop and Factory)*—A graduate of Princeton University with the degrees of mechanical and electrical engineer; has had a large experience in mining engineering and electrical manufacturing and in the supervision of large manufacturing plants; his present position is that of factory supervisor of the National Cash Register Company, Dayton, Ohio, U. S. A.

WALTER M. McFARLAND *(The Growth of Economy in Marine Engineering)*—Born in 1859. Educated in public schools of Washington, D. C., and at U. S. Naval Academy, where he graduated as a cadet engineer in 1879. Served on naval vessels in various parts of the world. Was assistant professor of mechanical engineering at Cornell University, by detail from the Navy; secretary of division of marine engineering of International Engineering Congress, 1893; delegate from United States Navy Department to International Congress of Naval Architects and Marine Engineers, 1897. Was twice assistant to Admiral Melville, Engineer-in-Chief, U. S. Navy, the last time as principal assistant. Member of board to reorganize personnel of United States Navy. Was promoted to grade of chief engineer in 1898. Resigned from the Navy in 1899, to go with the Westinghouse Electric and Manufacturing Company, of which he is acting vice-president.

PERCY LONGMUIR *(Emotion and Reason among British Workmen)*—Served an apprenticeship in Sheffield to steel, iron, and brass founding; trained as a metallurgist in the laboratories of the Sheffield University College; possesses a wide experience of Scotch and English methods of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SIDNEY F. WALKER *(Electric Appliances in Ship-Building Yards)*—Born 1852; educated at Christ's Hospital, from which he passed into H. M. S. "Britannia," training ship for naval cadets; served in the Navy at various stations, eventually being allowed to retire on favourable terms; studied for a time in telegraph schools, and then obtained an appointment on the staff of Sir W. Thomson; later had charge of the core-testing at Mitcham. Member of the Institution of Electrical Engineers, of the Institution of Mechanical Engineers of the Federated Mining Institute, of the South Wales Institute of Engineers, associate member of the Institution of Civil Engineers, member of the Institute of Marine Engineers, and of the American Institute of Electrical Engineers. One of the original Fellows of the Imperial Society. Frequent contributor to technical literature.

A. COOPER KEY *(The Railway Reorganisation of the Transvaal)*—Resident for four years at Johannesburg, occupied in mining journalism, also Mining Editor of the *South African Mining Journal;* Rand correspondent of the *Bullionist;* author of the book "Why Kruger Made War"; Prof. Assoc. Surv. Inst.

KENNETH FALCONER *(The Numerical Recording of Shipping and Manufacturing Orders)*—Residing in Montreal, where he was educated at school and in commercial occupations, giving especial attention to business accounting. Has devoted much attention to cost-keeping, and is at present practicing as an expert in Factory Accounting in Montreal.

WILLIAM GILBERT IRWIN *(The Briquetting of Fuels and Fine Mineral Ores)*—Born, reared, and schooled in the coal and coke fields of Western Pennsylvania and about the industrial establishments of the Pittsburg district, and for the past six years engaged in special literary work with reference to this district, contributing to many of the leading industrial and technical publications both in the United States and in Britain. At present American representative of *Colliery Guardian* and other British and Continental journals; has contributed extensively to *Scientific American, Engineering and Mining Journal, Coal Trade Journal* and other American publications. Author of some shorter treatises on industrial and technical subjects. At fall of Manila and in campaigns through the jungles after Aguinaldo. Later in China, and traveled in Japan, India, and other eastern countries.

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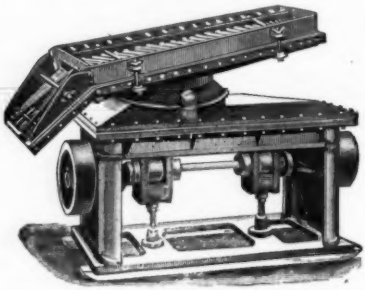

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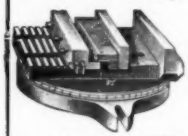

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Snow Steam Pump Works, Buffalo, N. Y.
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John Simmons Co., 110 Centre St., New York.

### Boiler Inspectors.

Hartford S. B. I. & Ins. Co., Hartford, Conn.

### Boiler-Makers' Tools.

Hilles & Jones Co., Wilmington, Del.
Niles Tool Works Co., Hamilton, Ohio.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Company, Worcester, Mass.
Stow Flexible Shaft Co., Philadelphia, Pa.

### Boilers—*See also Water-Tube Boilers.*

Abendroth & Root Mfg. Co., 99 John St., New York.
Allis-Chalmers Co., Chicago, Ill.
American Well Works, Aurora, Ill.
Atlantic Works, East Boston, Mass.
Aultman Company, Canton, Ohio.
Babcock & Wilcox Co., 85 Liberty St., New York.
Chandler & Taylor Co., Indianapolis, Ind.
Earle C. Bacon, 26 Cortlandt St., New York.
Keystone Driller Co., Beaver Falls, Pa.
Hammond Mfg. Co., Warren, Pa.
Riter-Conley Mfg. Co., Pittsburg, Pa.
S. Morgan Smith Co., York, Pa.
Star Drilling Machine Co., Akron, Ohio.
The Stirling Co., Chicago, Ill.

### Books.

Theo. Audel & Co., 63 Fifth Ave., New York.
Association of Engineering Societies, Phila., Pa.
Henry Carey Baird & Co., 810 Walnut St., Philadelphia, Pa.
Eng'g Magazine Press, 120-122 Liberty St., N. Y.

### Book Typewriters.

Elliott & Hatch Book Typewriter Co., 256 Broadway, New York.

### Boring Mills.

American Tool Works Co., Cincinnati, Ohio.
Baush Machine Tool Co., Springfield, Mass.
J. A. Fay & Egan Co., 212-232 West Front St., Cincinnati, Ohio.
Grant Tool Co., Franklin, Pa.
Niles Tool Works Co., Hamilton, Ohio.
Pond Machine Tool Co., Plainfield, N. J.
Wm. Sellers & Co., Inc., Philadelphia, Pa.

### Box Makers' Machinery.

J. A. Fay & Egan Co., 212-232 West Front St., Cincinnati, Ohio.

### Brazing Materials.

American Ferrofix Co., 20 Broad St., New York.

### Brick.

Henry Maurer & Son, 420 E. 23d St., New York.

### Brick and Tile Machinery.

American Blower Co., Detroit, Mich.
Jeffrey Mfg. Co., Columbus, Ohio.
Massachusetts Fan Co., 53 State St., Boston, Mass.
Vulcan Iron Works Co., Toledo, Ohio.

### Briquetting Machinery.

Henry S. Mould Co., Pittsburg, Pa.

### Cable-Railway Machinery.

Allis-Chalmers Co., Chicago, Ill.
A. Leschen & Sons Rope Co., St. Louis, Mo.
Hazard Mfg. Co., Wilkes-Barre, Pa.
John A. Mead Mfg. Co., 11 Broadway, New York.
R. Poole & Son Co., Baltimore, Md.

### Cables, Electric and Submarine.

General Electric Co., New York.
Hazard Mfg. Co., Wilkes-Barre, Pa.
John A. Roebling's Sons Co., Trenton, N. J.
Sprague Electric Co., 527 W. 34th St., New York.
Western Electric Company Chicago, Ill.

### Cables, Wire.

Geo. B. Carpenter & Co., Chicago, Ill.
Cooper, Hewitt & Co., 17 Burling Slip, New York.
A. Leschen & Sons Rope Co., St. Louis, Mo.
Lidgerwood Mfg. Co., 96 Liberty St., New York.
John A. Roebling's Sons Co., Trenton, N. J.
Trenton Iron Co., Trenton, N. J.

### Calculating Machines.

Carlton Mfg. Co., Carlton Hills, N. J.
Felt & Tarrant Mfg. Co., Chicago, Ill.

### Card Index Files.

Shaw-Walker Co., Muskegon, Mich.
The Fred Macey Co., Grand Rapids, Mich.
Vetter Desk Co., Rochester, N. Y.

### Car Shop Machinery.

J. A. Fay & Egan Co., 212-232 West Front St., Cincinnati, Ohio.
Hilles & Jones Co., Wilmington, Del.
Niles Tool Works Co., Hamilton, Ohio.
Pond Machine Tool Co., Plainfield, N. J.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Company, Worcester, Mass.

### Cars, Steel.

Pressed Steel Car Co., Pittsburg, Pa.

### Carriage and Wagon Machinery.

American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
J. A. Fay & Egan Co., 212-232 West Front St., Cincinnati, Ohio.
Stow Flexible Shaft Co., Philadelphia, Pa.
Stow Manufacturing Co., Binghamton, N. Y.

### Cast Iron Pipe—*See Pipe.*

### Castings, Iron, Steel and Brass.

Allis-Chalmers Co., Chicago, Ill.
Aultman Company, Canton, Ohio.
Bethlehem Steel Co., So. Bethlehem, Pa.
Stanley G. Flagg & Co., Philadelphia, Pa.
A. A. Griffing Iron Co., 66-68 Centre St., New York; Works, Jersey City.
Jeffrey Mfg. Co., Columbus, Ohio.
Maryland Steel Co., Sparrows Point, Md.
J. S. Mundy, Newark, N. J.
Pennsylvania Steel Co., Steelton, Pa.
Paul S. Reeves & Son, Philadelphia, Pa.
John Simmons Co., 110 Centre St., New York.
S. Morgan Smith Co., York, Pa.
Walworth Manufacturing Co., Boston, Mass.

### Cement Machinery.

Allis-Chalmers Co., Chicago, Ill.
Bethlehem Fdy. & Mch. Co., South Bethlehem, Pa.
Dodge Mfg. Co., Mishawaka, Ind.
Jeffrey Mfg. Co., Columbus, Ohio.
Link-Belt Eng'g Co., Nicetown, Philadelphia, Pa.
F. L. Smidth & Co., 66 Maiden Lane, New York.
Vulcan Iron Works Co., Toledo, Ohio.

### Cement—Portland.

American Cement Co., Philadelphia, Pa.
Atlas Portland Cement Co., 143 Liberty St., N. Y.
H. W. Johns Mfg. Co., 100 William St., New York.
Kelley Island Lime & Transport Co., Cleveland, O.

### Chain Belting.

Aultman Company, Canton, Ohio.
Jeffrey Manufacturing Co., Columbus, Ohio.
Link-Belt Eng'g Co., Nicetown, Philadelphia, Pa.
J. G. Speidel, Reading, Pa.
Standard Tool and Machine Co., Wilmington, Del.

### Chemicals.

American Ferrofix Co., 20 Broad St., New York.
Harrison Bros. & Co., Inc., Philadelphia, Pa.
Roessler & Hasslacher Chem. Co., 100 William St., N. Y.

### Chemical Works Machinery.

Atlantic Works, East Boston, Mass.

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### Chemists.

Chas. Catlett, Staunton, Va.
L. B. Darling, 79 Sabin St., Providence, R. I.
Robt. W. Hunt & Co., Chicago, Ill.

### Chucks

Skinner Chuck Co., New Britain, Conn.

### Circuit Breakers.

Cutter Co., 19th and Hamilton Sts., Philadelphia.

### Clay-Working Machinery.

American Blower Co., Detroit, Mich.
Aultman Company, Canton, Ohio.
Jeffrey Mfg. Co., Columbus, Ohio.
Link-Belt Eng'g Co., Nicetown, Philadelphia, Pa.
Vulcan Iron Works, Toledo, Ohio.

### Clocks—Time Recording.

American Watchman's Time Detector Co., 234 Broadway, New York.
E. Howard Clock Co., 395 Washington St., Boston, Mass., 43 Maiden Lane, New York.

### Clutch Pulleys.

Jacobson Machine Mfg. Co., Warren, Pa.

### Coal and Ashes-Handling Machinery.

Aultman Company, Canton, Ohio.
Geo. Haiss Mfg. Co., 141st St. & Rider Ave., N. Y.
C. W. Hunt Co., West New Brighton, New York.
Jeffrey Mfg. Co., Columbus, Ohio.
A. Leschen & Sons Rope Co., St. Louis, Mo.
Link-Belt Eng'g Co., Nicetown, Philadelphia, Pa.
John A. Mead Mfg. Co., 11 Broadway, New York.
Robins Conveying Belt Co., 14-22 Park Row, N. Y.

### Coal-Mining Machinery.

Allis-Chalmers Co., Chicago, Ill.
Geo. F. Blake Mfg. Co., 91 Liberty St., New York.
Buffalo Forge Co., Buffalo, N. Y.
General Electric Co., New York.
C. W. Hunt Co., West New Brighton, New York.
Ingersoll-Sergeant Drill Co., 26 Cortlandt St., N. Y.
Jeffrey Manufacturing Co., Columbus, Ohio.
Knowles Steam Pump Wks., 91 Liberty St., N. Y.
Arthur Koppel, 68 Broad St., New York.
Laidlaw-Dunn-Gordon Co., Cincinnati, Ohio.
Lambert Hoisting Engine Co., Newark, N. J.
A. Leschen & Sons Rope Co., St. Louis, Mo.
Link-Belt Eng'g Co., Nicetown, Philadelphia, Pa.
John H. McGowan Co., Cincinnati, Ohio.
Norwalk Iron Works, South Norwalk, Conn.
Rand Drill Co., 128 Broadway, New York.
Robins Conveying Belt Co., 14-22 Park Row, N. Y.
Triumph Electric Co., Cincinnati, Ohio.
Vulcan Iron Works Co., Toledo, Ohio.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

### Coal Screens.

Allis-Chalmers Co., Chicago, Ill.
Geo. B. Carpenter & Co., Chicago, Ill.
Hendrick Mfg. Co., Ltd., Carbondale, Pa.
Jeffrey Manufacturing Co., Columbus, Ohio.
Link-Belt Eng'g Co., Nicetown, Philadelphia, Pa.
John A. Mead Mfg. Co., 11 Broadway, New York.

### Condensers.

Allis-Chalmers Co., Chicago, Ill.
Geo. F. Blake Mfg. Co., 91 Liberty St., New York.
Deane Steam Pump Co., Holyoke, Mass.
Hammond Mfg. Co., Warren, Pa.
Holly Mfg. Co., 120 Liberty St., New York.
Knowles Steam Pump Wks., 91 Liberty St., N. Y.
Laidlaw-Dunn-Gordon Co., Cincinnati, Ohio.
John H. McGowan Co., Cincinnati, Ohio.
Snow Steam Pump Works, Buffalo, N. Y.
Stilwell-Bierce & Smith-Vaile Co., Dayton, O.
Henry R. Worthington, 120 Liberty St., New York.

### Continuous Rolling Mills.

Morgan Construction Co., Worcester, Mass.

### Conveying Machinery.

Aultman Company, Canton, Ohio.
Earle C. Bacon, 26 Cortlandt St., New York.
E. A. Blanton, Jr., Philadelphia, Pa.
Frick Company, Waynesboro, Pa.
Heyl & Patterson, Pittsburg, Pa.
C. W. Hunt Co., West New Brighton, New York.
Jeffrey Mfg. Co., Columbus, Ohio.
Arthur Koppel, 68 Broad St., New York.
A. Leschen & Sons Rope Co., St. Louis, Mo.
Lidgerwood Mfg. Co., 96 Liberty St., New York.
Link-Belt Eng'g Co., Nicetown, Philadelphia, Pa.
John A. Mead Mfg. Co., 11 Broadway, New York.
Robins Conveying Belt Co., 14-22 Park Row, N. Y.

### Copper.

Orford Copper Co., 37 Wall St., New York.

### Cranes.

American Hoist & Derrick Co., St. Paul, Minn.
Earle C. Bacon, 26 Cortlandt St., New York.
Brown Hoisting Mchy. Co., Inc., Cleveland, O.
Browning Engineering Co., Cleveland, Ohio.
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Garry Iron & Steel Co., Cleveland, Ohio.
Northern Engineering Works, Detroit, Mich.
Pawling Harnischfeger, Milwaukee, Wis.
Pedrick & Ayer Co., Philadelphia, Pa.
Riter-Conley Mfg. Co., Pittsburg, Pa.
Wm. Sellers & Co., Philadelphia, Pa.
Shaw Electric Crane Co., Muskegon, Mich.
J. G. Speidel, Reading, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.
R. D. Wood & Co., Philadelphia, Pa.

### Crushers—Ore, Phosphate, Rock.

Allis-Chalmers Co., Chicago, Ill.
Aultman Company, Canton, Ohio.
Earle C. Bacon, 26 Cortlandt St., New York.
E. A. Blanton, Jr., Philadelphia, Pa.
Jeffrey Mfg. Co., Columbus, Ohio.
F. L. Smidth & Co., 66 Maiden Lane, New York.
Sturtevant Mill Co., Boston, Mass.

### Cupolas.

Northern Engineering Works, Detroit, Mich.
Riter-Conley Mfg. Co., Pittsburg, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

### Cutters, Milling.

Brown & Sharpe Mfg. Co., Providence, R. I.

### Diamond Drills.

American Diamond Rock Drill Co., 120 Liberty St., New York.
American Well Works, Aurora, Ill.
Davis Calyx Drill Co., 128 Broadway, New York.
Ingersoll-Sergeant Drill Co., 26 Cortlandt St., N. Y.
Rand Drill Co., 128 Broadway, New York.

### Digesters.

Atlantic Works, East Boston, Mass.
Eastwood Wire Mfg. Co., Belleville, N. J.
Riter-Conley Mfg. Co., Pittsburg, Pa.

### Draw Benches, Wire.

Trenton Iron Co., Trenton, N. J.
Watson-Stillman Co., 204 East 43d St., New York.

### Draught Gauges.

Hohmann & Maurer Mfg. Co., Rochester, N. Y.

### Draughtsmen's Instruments and Materials.

Theo. Alteneder & Sons, Philadelphia, Pa.
Brandis Sons Co., Brooklyn, N. Y.
Brown & Sharpe Mfg. Co., Providence, R. I.
Eugene Dietzgen Co., 181 Monroe St., Chicago, Ill.
Keuffel & Esser Co., New York.
Queen & Co., Inc., Philadelphia, Pa.

### Dredges—See Excavators.

### Drilling Machines.

American Tool Works Co., Cincinnati, Ohio.
B. F. Barnes Co., Rockford, Ill.
Baush Machine Tool Co., Springfield, Mass.
H. G. Barr & Co., Worcester, Mass.
W. F. & John Barnes Co., Rockford, Ill
Bickford Drill & Tool Co., Cincinnati, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
The Geo. Burnham Co., Worcester, Mass.
Thos. H. Dallett & Co., Philadelphia, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Tool Co., Franklin, Pa.
Niles Tool Works Co., Hamilton, Ohio.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.

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Pond Machine Tool Co., Plainfield, N. J.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Company, Worcester, Mass.
Wm. Sellers & Co., Inc., Philadelphia, Pa.
Stow Flexible Shaft Co., Philadelphia, Pa.
Stow Manufacturing Co., Binghamton, N. Y.

## Drills—Rock and Coal.

American Diamond Rock Drill Co., 120 Liberty St., New York.
E. A. Blanton, Jr., Philadelphia, Pa.
H. D. Crippen, 52 B'way, N. Y.
Clayton Air Compress. Wks., 120 Liberty St., N.Y.
Davis Caiyx Drill Co., 128 Broadway, New York.
Hall Steam Pump Co., Pittsburg, Pa.
Ingersoll-Sergeant Drill Co., 26 Cortlandt St., N. Y.
Jeffrey Mfg. Co., Columbus, Ohio.
Keystone Driller Co., Beaver Falls, Pa.
McKiernan Drill Co., 120 Liberty St., New York.
Raud Drill Co., 128 Broadway, New York.
Star Drilling Machine Co., Akron, Ohio.

## Drying and Calcining Machines.

American Blower Co., Detroit, Mich.
Earle C. Bacon, 26 Cortlandt St., New York.
Buffalo Forge Co., Buffalo, N. Y.
Harrison Safety Boiler Works, Philadelphia, Pa.
Jeffrey Mfg. Co., Columbus, Ohio.
Massachusetts Fan Co., 53 State St., Boston, Mass.
B. F. Sturtevant Co., Jamaica Plain Station, Boston, Mass.

## Dynamos.

American Engine Co., Bound Brook, N. J.
Bullock Electric Mfg. Co., Cincinnati, Ohio.
Chas. J. Bogue, 217 Centre St., New York.
Crocker-Wheeler Co., Ampere, N. J.
C & C Electric Co., 143 Liberty St., New York.
Eddy Electric Mfg. Co., Windsor, Conn.
General Electric Co., New York.
Guarantee Electric Co., Chicago, Ill.
Jantz & Leist Electric Co., Cincinnati, Ohio.
Jeffrey Mfg. Co., Columbus, Ohio.
Schureman & Hayden, 137 So. Clinton St., Chicago, Ill.
Sprague Electric Co., 527 W. 34th St., New York.
B. F. Sturtevant Co., Jamaica Plain Station, Boston, Mass.
Triumph Electric Co., Cincinnati, Ohio.
Western Electric Company, Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

## Ejectors.

Hayden & Derby Mfg. Co., New York.
Watson & McDaniel Co., Philadelphia, Pa.

## Electrical Machinery and Supplies.

American Engine Co., Bound Brook, N. J.
Geo. F. Blake Mfg. Co., 91 Liberty St., New York.
Bristol Co., Waterbury, Conn.
Bullock Electric Mfg. Co., Cincinnati, Ohio.
C & C Electric Co., 143 Liberty St., New York.
Crocker-Wheeler Co., Ampere, N. J.
Deane Steam Pump Co., Holyoke, Mass.
Eddy Electric Mfg. Co., Windsor, Conn.
General Electric Co., New York.
Holly Mfg. Co., 120 Liberty St., New York.
Jantz & Leist Electric Co., Cincinnati, Ohio.
Jeffrey Mfg. Co., Columbus, Ohio.
H. W. Johns Mfg. Co., 100 William St., New York.
Knowles Steam Pump Wks., 91 Liberty St., N. Y.
Laidlaw-Dunn-Gordon Co., Cincinnati, Ohio.
Massachusetts Fan Co., 53 State St., Boston, Mass.
M. M. Mayer Elec. Co., 2369 Second Ave., N. Y.
Wm. E. Quimby, Inc., 86 Liberty St., New York.
Schureman & Hayden, 137 So. Clinton St., Chicago, Ill.
Snow Steam Pump Works, Buffalo, N. Y.
Sprague Electric Co., 527 W. 34th St., New York.
B. F. Sturtevant Co., Jamaica Plain Station, Boston, Mass.
Triumph Electric Co., Cincinnati, Ohio.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.
Westinghouse, Church, Kerr & Co., 26 Cortlandt St., New York.
Western Electric Company, Chicago, Ill.
Weston Elec. Inst. Co., Waverly Pk., Essex Co., N.J.
Henry R. Worthington, 120 Liberty St., New York.

## Elevators.

American Tool & Machine Co., Boston, Mass.
Aultman Co., Canton, Ohio.
Jeffrey Mfg. Co., Columbus, Ohio.
Link-Belt Eng'g Co., Nicetown, Philadelphia, Pa.
John A. Mead Mfg. Co., 11 Broadway, New York.
R. Poole & Son Co., Baltimore, Md.
J. G. Speidel, Reading, Pa.
Triumph Electric Co., Cincinnati, Ohio.
Whiting Foundry Equipment Co., Harvey, Ill.

## Emery Wheels.

Geo. B. Carpenter & Co., Chicago, Ill.
Stow Flexible Shaft Co., Philadelphia, Pa.

## Engineers.

Wm. S. Aldrich, Potsdam, N. Y.
Allis-Chalmers Co., Chicago, Ill.
Clay Belsley, Peoria, Ill.
William M. Brewer, Molson's Bank Building, Vancouver, B. C.
G. M. Brill, 1143-5 Marquette Bldg., Chicago, Ill.
Madison Cooper, Minneapolis, Minn.
W. Dusedau, 529 Min'g Exchge Bldg., Denver, Colo.
Heyl & Patterson, Pittsburg, Pa.
Holt & Schober, 378 Bourse, Philadelphia, Pa.
S. V. Huber & Co., 702-707 Ferguson Block, Pittsburg, Pa.
Robt. W. Hunt & Co., 1121 The Rookery, Chicago, Ill.
Iron City Engineering Co., Pittsburg, Pa.
Julian Kennedy, Pittsburg, Pa.
Walter Kennedy, Pittsburg, Pa.
G. W. McClure, Son & Co., Smith Block, Pittsburg, Pa.
Morgan Construction Co., Worcester, Mass.
Orlan Clyde Cullen, 709 7th St., N. W., Washington, D. C.
Pittsburg Valve, Fdy. & Cons. Co., Pittsburg, Pa.
Robert McF. Doble, Mills Building, San Francisco, Cal.
C. L. Redfield, 269 Dearborn St., Chicago, Ill.
Rockwell Engineering Co., 26 Cortlandt St., N. Y.
Providence Engineering Works, Providence, R. I.
Sydney F. Reynolds, Torry, Pa.
H. B. Roelker, 41 Maiden Lane, New York.
Westinghouse Machine Co., Pittsburg, Pa.
Westinghouse, Church, Kerr & Co., 26 Cortlandt St., New York.

## Engines, Blowing.

Allis-Chalmers Co., Chicago, Ill.
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Sprague Electric Co., 527 W. 34th St., New York.

## Engines—Gas, Gasoline, and Petroleum.

American Well Works, Aurora, Ill.
Aultman Company, Canton, Ohio.
Gas Engine & Power Co., Morris Heights, N. Y.
A. Meitz, 128-138 Mott St., New York.
Northern Engineering Works, Detroit, Mich.
Charles L. Seabury & Co., Morris Heights, N. Y.
Struthers, Wells & Co., Warren, Pa.
Westinghouse Machine Co., Pittsburg, Pa.
Westinghouse, Church, Kerr & Co., 26 Cortlandt St., New York.

## Engines, Marine.

Atlantic Works, East Boston, Mass.
Gas Engine & Power Co., Morris Heights, N. Y.
Kingsford Fdy. & Mch. Works, Oswego, N. Y.
Charles L. Seabury & Co., Morris Heights, N. Y.

## Engines, Stationary.

Allis-Chalmers Co., Chicago, Ill.
American Blower Co., Detroit, Mich.
American Engine Co., Bound Brook, N. J.
American Well Works, Aurora, Ill.
Aultman Company, Canton, Ohio.
Earle C. Bacon, 26 Cortlandt St., New York.
Ball Engine Co., Erie, Pa.
Ball & Wood Co., 120 Liberty St., New York.
A. F. Bartlett & Co., Saginaw, Mich.
Bradley Mfg. Co., Pittsburg, Pa.
Brown Corliss Engine Co., Milwaukee, Wis.
Buffalo Forge Co., Buffalo, N. Y.
Chandler & Taylor Co., Indianapolis, Ind.
Erie Pump & Engine Co., Erie, Pa.
Frick Company, Waynesboro, Pa.
Harrisburg Fdy. & Mch. Co., Harrisburg, Pa
Hooven, Owens Rentschler Co., Hamilton, Ohio.
James Leffel & Co., Springfield, O.
Providence Engineering Works, Providence, R. I.
Star Drilling Machine Co., Akron, Ohio.
B. F. Sturtevant Co., Jamaica Plain Station, Boston, Mass.
Webster, Camp & Lane Machine Co., Akron, Ohio.

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Westinghouse Machine Co., Pittsburg, Pa.
Westinghouse, Church, Kerr & Co., 26 Cortlandt St., New York.
The William Tod Co., Youngstown, Ohio.

## Engine Stops.

Consolidated Engine Stop Co., Waterbury, Conn.

## Engravers.

A. Mugford, 120 Liberty St., New York.
C. P. Zacher & Co., 221 Fifth Ave., Chicago, Ill.

## Excavators.

Atlantic, Gulf & Pacific Co., Park Row Bldg., N. Y.
Aultman Company, Canton, Ohio.
Bucyrus Co., So. Milwaukee, Wis.
Kingsford Fdy. & Mch. Works, Oswego, N. Y.
Jeffrey Mfg. Co., Columbus, Ohio.
A. Leschen & Sons Rope Co., St. Louis, Mo.
Marion Steam Shovel Co., Marion, Ohio.
Robins Conveying Belt Co., 14-22 Park Row, N. Y.
Vulcan Iron Works, Toledo, Ohio.

## Exhaust Heads.

Boston Blower Co., Hyde Park, Mass.
Direct Separator Co., Syracuse, N. Y.
A. A. Griffing Iron Co., 66-68 Centre St., New York; Works, Jersey City.
B. F. Sturtevant Co., Jamaica Plain Station, Boston, Mass.
Watson & McDaniel Co., Philadelphia, Pa.

## Fans, Ventilating.

Allis-Chalmers Co., Chicago, Ill.
American Blower Co., Detroit, Mich.
Boston Blower Co., Hyde Park, Mass.
Buffalo Forge Co., Buffalo, N. Y.
Massachusetts Fan Co., 53 State St., Boston, Mass.
Monongahela Mfg. Co., Monongahela, Pa.
Power Specialty Co., 126 Liberty St., New York.
Sprague Electric Co., 527 W. 34th St., New York.
B. F. Sturtevant Co., Jamaica Plain Station, Boston, Mass.
Western Electric Company, Chicago, Ill.

## Feed-Water Heaters and Purifiers.

Allis-Chalmers Co., Chicago, Ill.
Earle C. Bacon, 26 Cortlandt St., New York.
Dodge Mfg. Co., Misbawaka, Ind.
Goubert Mfg. Co., 85 Liberty St., New York.
Green Fuel Economizer Co., Matteawan, N. Y.
A. A. Griffing Iron Co., 66-68 Centre St., New York; Works, Jersey City.
Harrison Safety Boiler Works, Philadelphia, Pa.
Hoppes Manufacturing Co., Springfield, Ohio.
John H. McGowan Co., Cincinnati, Ohio.
Providence Engineering Works, Providence, R. I.
Ross Valve Co., Troy, N. Y.
Stewart Heater Co., Buffalo, N. Y.
Stilwell-Bierce & Smith-Vaile Co., Dayton, O.
Warren Webster & Co., Camden, N. J.

## Ferrofix.

American Ferrofix Co., 20 Broad St., New York.

## Fertilizer Machinery.

Aultman Company, Canton, Ohio
Jeffrey Mfg. Co., Columbus, Ohio
Link-Belt Eng'g Co., Nicetown, Philadelphia, Pa.

## Files and Rasps.

G. & H. Barnett Co., Philadelphia, Pa.
Geo. B. Carpenter & Co., Chicago, Ill.

## Filters.

New York Cont. Jewell Filt. Co., 15 Broad St., N. Y.

## Fire Brick.

Henry Maurer & Son, 420 East 23d St., New York.

## Fireproof Building Materials.

Henry Maurer & Son, 420 East 23d St., New York.
National Fireproofing Co., Pittsburg, Pa.

## Flanges.

Latrobe Steel Co., 1200 Girard Bldg., Phila., Pa.

## Flexible Shafts.

Stow Flexible Shaft Co., Philadelphia, Pa.
Stow Manufacturing Co., Binghamton, N. Y.

## Floor and Sidewalk Lights.

T. H. Brooks & Co., Cleveland, Ohio.

## Flue Cleaners.

Stephenson Mfg. Co., Albany, N. Y.

## Flushing Valves.

Kenney Company, 72-74 Trinity Place, N. Y.,

## Fluxes.

American Ferrofix Co., 20 Broad St., New York.

## Fly Wheels.

Allis-Chalmers Co., Chicago, Ill.
Dodge Mfg. Co. Mishawaka, Ind.
R. Poole & Son Co., Baltimore, Md.
S. Morgan Smith Co., York, Pa.
The Stilwell-Bierce & Smith-Vaile Co., Dayton, O.

## Forges.

Buffalo Forge Co., Buffalo, N. Y.
Boston Blower Co., Hyde Park, Mass.
B. F. Sturtevant Co., Jamaica Plain Station, Boston, Mass.

## Forgings, Iron and Steel.

Chester B. Albree, Allegheny, Pa.
Keystone Drop Forge Works, Philadelphia, Pa.
Maryland Steel Co., Sparrows Point, Md.
Pennsylvania Steel Co., Steelton, Pa.
Strieby & Foote Co., Newark, N. J.
J. H. Williams & Co., 9 Richards St., Brooklyn, N.Y.
Wyman & Gordon, Worcester, Mass.

## Foundry Equipment.

Blanchard Machine Co., Boston, Mass.
J. B. & J. M. Cornell, 26th St. & Eleventh Ave., New York.
Arthur Koppel, 68 Broad St., New York.
Northern Engineering Works, Detroit, Mich.
Pedrick & Ayer Co., Philadelphia, Pa.
Shaw Electric Crane Co., Muskegon, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

## Friction Clutches.

American Tool & Machine Co., Boston, Mass.
Christiana Machine Co., Christiana, Pa.
Dodge Mfg. Co., Misbawaka, Ind.
Eastern Machinery Co., New Haven, Conn.
Link-Belt Eng'g Co., Nicetown, Philadelphia, Pa.
R. Poole & Son Co., Baltimore, Md.
S. Morgan Smith Co., York, Pa.
The Stilwell-Bierce & Smith-Vaile Co., Dayton, O.

## Fuel Economizers.

Green Fuel Economizer Co., Matteawan, N. Y.
Providence Engineering Works, Providence, R. I.
Steam Boiler Equipment Co., 20 W. Houston St., New York.

## Fuel Gas Producer.

Loomis-Pettibone Co., 52 Broadway, New York.

## Furnace Builders.

American Gas Furnace Co., 23 John St., New York.
Continental Iron Wks., West & Calyer Sts., Brooklyn, N. Y.
Julian Kennedy, Pittsburg, Pa.
G. W. McClure, Son & Co., Smith Block, Pittsburg, Pa.
Morgan Construction Co., Worcester, Mass.
Riter-Conley Mfg. Co., Pittsburg, Pa.
Rockwell Engineering Co., 26 Cortlandt St., N. Y.
Whiting Foundry Equipment Co., Harvey, Ill.

## Gages—Pressure, Steam, Water, etc.

Ashcroft Mfg. Co., 85-89 Liberty St., New York.
Ashton Valve Co., Boston, Mass.
Bristol Co., Waterbury, Conn.
Crosby Steam Gage & Valve Co., Boston, Mass.
Hohmann & Maurer Mfg. Co., Rochester, N. Y.
John Simmons Co., 110 Centre St., New York.
Star Brass Mfg. Co., Boston, Mass.
Walworth Manufacturing Co., Boston, Mass.
Williams Gauge Co., W. Pittsburg, Pa.

## Galvanizing.

John Simmons Co., 110 Centre St., New York.
U. S. Electro-Galvanizing Co., 348 Broadway, N. Y.

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### Gas Holders and Regulators.

Continent. Iron Wks., West & Calyer Sts., Brooklyn, N. Y.
Jacobson Machine Mfg. Co., Warren, Pa.
Riter-Conley Mfg. Co., Pittsburg, Pa.
R. D. Wood & Co., Philadelphia, Pa.

### Gaskets, Metallic.

Geo. B. Carpenter & Co., Chicago, Ill.
H. W. Johns Mfg. Co., 100 William St., New York.
Merwarth Metal. Gasket Co., 107 Liberty St., N. Y.

### Gas Machines and Generators.

American Gas Furnace Co., 23 John St., New York.
Dufs Patents Co., Pittsburg, Pa.
Link-Belt Eng'g Co., Nicetown, Philadelphia, Pa.
Morgan Construction Co., Worcester, Mass.
R. D. Wood & Co., Philadelphia, Pa.
Walworth Manufacturing Co., Boston, Mass.

### Gas Soldering Furnaces.

Jacobson Machine Mfg. Co., Warren, Pa.

### Gear Cutting Machines.

Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Gould & Eberhardt, Newark, N. J.

### Gearing.

Allis-Chalmers Co., Chicago, Ill.
Hugo Bilgram, 440 No. 12th St., Philadelphia, Pa.
Geo. F. Blake Mfg. Co., 91 Liberty St., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Christiana Machine Co., Christiana, Pa.
Dodge Mfg. Co., Mishawaka, Ind.
Gould & Eberhardt, Newark, N. J.
Jacobson Mch. Mfg. Co., Warren, Pa.
Jeffrey Mfg. Co., Columbus, Ohio.
Knowles Steam Pump Wks., 91 Liberty St., N. Y
Morse, Williams & Co., Philadelphia, Pa.
J. S. Mundy, Newark, N. J.
New Process Rawhide Co., Syracuse, N. Y.
R. Poole & Son Co., Baltimore, Md.
William Sellers & Co., Inc., Philadelphia, Pa.
S. Morgan Smith Co., York, Pa.
Stow Flexible Shaft Co., Philadelphia, Pa.
The Stilwell-Bierce & Smith-Vaile Co., Dayton, O

### Grain Elevator Machinery.

Allis-Chalmers Co., Chicago, Ill.
Aultman Co., Canton, Ohio.
Dodge Mfg. Co., Mishawaka, Ind.
Jeffrey Mfg. Co., Columbus, Ohio.
Link-Belt Eng'g Co., Nicetown, Philadelphia, Pa.
Riter-Conley Mfg. Co., Pittsburg, Pa.
Robins Conveying Belt Co., 14-22 Park Row, N. Y.

### Graphite.

Geo. B. Carpenter & Co., Chicago, Ill.
Jos. Dixon Crucible Co., Jersey City, N. J.
Graphite Lubricating Co., Bound Brook, N. J.

### Greases.

Keystone Lubricating Co., Philadelphia, Pa.

### Grinding and Polishing Machinery.

American Tool Works Co., Cincinnati, Ohio.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Machine Co., Providence, R. I.
Dodge Mfg. Co. Mishawaka, Ind.
Landis Tool Co., Waynesboro, Pa.
Niles Tool Works Co., Hamilton, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Wm. Sellers & Co., Inc., Philadelphia, Pa.
F. L. Smidth & Co., 66 Maiden Lane, New York.
Stow Flexible Shaft Co., Philadelphia, Pa.

### Handpower Cranes and Winches.

American Hoist & Derrick Co., St. Paul, Minn.

### Hangers—*See Pulleys.*

### Heating and Ventilating Apparatus.

American Blower Co., Detroit, Mich.
Boston Blower Co., Hyde Park, Mass.
Buffalo Forge Co., Buffalo, N. Y.
J. B. & J. M. Cornell, 26th St. & Eleventh Ave., New York.
A. A. Griffing Iron Co., 66-68 Centre St., New York; Works, Jersey City.
Hayden & Derby Mfg. Co., New York.
Massachusetts Fan Co., 53 State St., Boston, Mass.
Power Specialty Co., 126 Liberty St., New York.
John Simmons Co., 110 Centre St., New York.
Sprague Electric Co., 527 W. 34th St., New York.
H. B. Smith Co., 137 Centre St., New York.
B. F. Sturtevant Co., Jamaica Plain Station, Boston, Mass.
Walworth Mfg. Co., Boston, Mass.

### Hoisting Engines and Machinery.

Allis-Chalmers Co., Chicago, Ill.
American Hoist & Derrick Co., St. Paul, Minn.
Aultman Company, Canton, Ohio.
Earle C. Bacon, 26 Cortlandt St., New York.
Brown Hoisting Machinery Co., Inc., Cleveland, O.
Browning Engineering Co., Cleveland, Ohio.
Geo. B. Carpenter & Co., Chicago, Ill.
Contractors' Plant Mfg. Co., Buffalo, N. Y.
Cooper, Hewitt & Co., 17 Burling Slip, New York.
Franklin Portable Crane & Hoist Co., Franklin, Pa.
C. W. Hunt Co., West New Brighton, New York.
Jeffrey Mfg. Co., Columbus, Ohio.
Lambert Hoisting Engine Co., Newark, N. J.
Lidgerwood Mfg. Co., 96 Liberty St., New York.
Link-Belt Eng'g Co., Nicetown, Philadelphia, Pa.
John A. Mead Mfg. Co., 11 Broadway, New York.
Monongahela Mfg. Co., Monongahela, Pa.
J. S. Mundy, Newark, N. J.
Niles Tool Works Co., Hamilton, Ohio.
Northern Engineering Works, Detroit, Mich.
Providence Engineering Works, Providence, R. I.
Wm. Sellers & Co., Inc., Philadelphia, Pa.
Trenton Iron Co., Trenton, N. J.
Vulcan Iron Works, Wilkesbarre, Pa.
Webster, Camp & Lane Machine Co., Akron, O.

### Hollow Chisel Mortisers.

J. A. Fay & Egan Co., 212-232 West Front St., Cincinnati, Ohio.

### Hose.

Boston Belting Co., Boston, Mass.

### Hydraulic Machinery.

Christiana Machine Co., Christiana, Pa.
John H. McGowan Co., Cincinnati, Ohio.
S. Morgan Smith Co., York, Pa.
R. Poole & Son Co., Baltimore, Md.
Stilwell-Bierce & Smith-Vaile Co., Dayton, O.
Watson & Stillman Co., 210 E. 43d St., New York.
R. D. Wood & Co., Philadelphia, Pa.

### Hydraulic Rams.

Power Specialty Co., 126 Liberty St., New York.

### Ice-Making and Refrigerating Machinery.

A. H. Barber Mfg. Co., Chicago, Ill.
Geo. F. Blake Mfg. Co., 91 Liberty St., New York.
Deane Steam Pump Co., Holyoke, Mass.
Frick Company, Waynesboro, Pa.
Holly Mfg. Co., 120 Liberty St., New York.
Knowles Steam Pump Wks., 91 Liberty St., N. Y.
Laidlaw-Dunn-Gordon Co., Cincinnati, Ohio.
H. B. Roelker, 41 Maiden Lane, New York.
Snow Steam Pump Works, Buffalo, N. Y.
Stilwell-Bierce & Smith-Vaile Co., Dayton, O.
Westinghouse Machine Co., Pittsburg, Pa.
Westinghouse, Church, Kerr & Co., 26 Cortlandt St., New York.
Henry R. Worthington, 120 Liberty St., New York.

### Incandescent Lamps—*See Lamps, Electric.*

### Industrial Railways.

Dodge Mfg. Co., Mishawaka, Ind.
C. W. Hunt Co., West New Brighton, New York.
Arthur Koppel, 68 Broad St., New York.
Link-Belt Eng'g Co., Nicetown, Philadelphia, Pa.
John A. Mead Mfg. Co., 11 Broadway, New York.
Whiting Foundry Equipment Co., Harvey, Ill.

### Injectors.

Hayden & Derby Mfg. Co., New York.
The Lunkenheimer Co., Cincinnati, Ohio.
John Simmons Co., 110 Centre St., New York.
Wm. Sellers & Co., Philadelphia, Pa.

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## Insulated Wire.

General Electric Co., New York.
Hazard Mfg. Co., Wilkes-Barre, Pa.
John A. Roebling's Sons Co., Trenton, N. J.
Sprague Electric Co., 527 W. 34th St., New York.

## Insulating Varnish.

Sterling Varnish Co., Pittsburg, Pa.

## Kiers.

Atlantic Works, East Boston, Mass.

## Lamps, Electric.

General Electric Co., New York.
General Incandescent Lamp Co., Cleveland, Ohio.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.
Western Electric Company, Chicago, Ill.

## Lathes.

American Tool & Machine Co., Boston, Mass.
American Tool Works Co., Cincinnati, Ohio.
W. F. & John Barnes Co., Rockford, Ill.
Cincinnati Milling Machine Co., Cincinnati, O.
Diamond Machine Co., Providence, R. I.
Gould & Eberhardt, Newark, N. J.
Grant Tool Co., Franklin, Pa.
Jones & Lamson Machine Co., Springfield, Vt.
Niles Tool Works Co., Hamilton, O.
Pond Machine Tool Co., Plainfield, N. J.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Company, Worcester, Mass.
Wm. Sellers & Co., Inc., Philadelphia, Pa.
W. C. Young Mfg. Co., Worcester, Mass.

## Leather, Hydraulic, Valve and Pump.

Chas. A. Schieren & Co., 45-51 Ferry St., New York.

## Lockers.

Merritt & Co., Philadelphia, Pa.
Narragansett Machinery Co., Providence, R. I.

## Locomotives, Steam.

American Locomotive Co., 25 Broad St., New York.
Baldwin Locomotive Works, Philadelphia, Pa.
H. K. Porter Co., Pittsburg, Pa.
Vulcan Iron Works, Wilkesbarre, Pa.

## Locomotives, Electric.

Baldwin Locomotive Works, Philadelphia, Pa.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
C. W. Hunt Co., West New Brighton, N. Y.
Jeffrey Mfg. Co., Columbus, Ohio.
Arthur Koppel, 68 Broad St., New York.
H. K. Porter Co., Pittsburg, Pa.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

## Lubricants.

Jos. Dixon Crucible Co., Jersey City, N. J.
Graphite Lubricating Co., Bound Brook, N. J.
Keystone Lubricating Co., Philadelphia, Pa.

## Machine Repairers.

American Ferrofix Co., 20 Broad St., New York.

## Machinery Salvage.

American Ferrofix Co., 20 Broad St., New York

## Machine Tools and Supplies.

Acme Machinery Co., Cleveland, Ohio.
American Tool & Machine Co., Boston, Mass.
American Tool Works Co., Cincinnati, O.
R. F. Barnes Co., Rockford, Ill.
W. F. & John Barnes Co., Rockford, Ill.
Baush Machine Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, Ohio.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Crane Co., Chicago, Ill.
Gould & Eberhardt, Newark, N. J.
Hilles & Jones Co., Wilmington, Del.
Jones & Lamson Machine Co., Springfield, Vt.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Niles Tool Works Co., Hamilton, O.
Pearson Machine Co., Chicago, Ill.
Pond Machine Tool Co., Plainfield, N. J.
Power Specialty Co., 126 Liberty St., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Company, Worcester, Mass.
Wm. Sellers & Co., Philadelphia, Pa.
Stow Flexible Shaft Co., Philadelphia, Pa.
Stow Manufacturing Co., Binghamton, N. Y.
Walworth Manufacturing Co., Boston, Mass.
Whitcomb Mfg. Co., Worcester, Mass.
W. C. Young Mfg. Co., Worcester, Mass.

## Machinists' Small Tools.

Acme Machinery Co., Cleveland, Ohio.
American Tool Works Co., Cincinnati, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
Brown & Sharpe Mfg. Co., Providence, R. I.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Wm. Sellers & Co., Inc., Philadelphia, Pa.

## Mechanical Draft.

American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Massachusetts Fan Co., 53 State St., Boston, Mass.
Power Specialty Co., 126 Liberty St., New York.
B. F. Sturtevant Co., Jamaica Plain Station, Boston, Mass.
Westinghouse Machine Co., Pittsburg, Pa.
Westinghouse, Church, Kerr & Co., 26 Cortlandt St., New York.

## Meters, Electric.

General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.
Weston Elec. Inst. Co., Waverly Pk., Essex Co., N.J.

## Milling Machines.

Adams Company, Dubuque, Iowa.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Grant Tool Co., Franklin, Pa.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles Tool Works Co., Hamilton, Ohio.
Pratt & Whitney Co., Hartford, Conn.

## Mill Supplies.

Phillips Mine & Mill Supply Co., Pittsburg, Pa.
Pittsburgh Gage & Supply Co., Pittsburgh, Pa.

## Mine Cars.

Allis-Chalmers Co., Chicago.
Earle C. Bacon, 26 Cortlandt St., New York.
C. W. Hunt Co., West New Brighton, N. Y.
Jeffrey Manufacturing Co., Columbus, Ohio.
Arthur Koppel, 68 Broad St., New York.
Monongahela Mfg. Co., Monongahela, Pa.
Watt Mining Car Wheel Co., Barnesville, Ohio.
Whiting Foundry Equipment Co., Harvey, Ill.

## Mining Machinery.

Allis-Chalmers Co., Chicago, Ill.
American Diamond Rock Drill Co., 120 Liberty St., New York.
Earle C. Bacon, 26 Cortlandt St., New York.
E. A. Blanton, Jr., Philadelphia, Pa.
Geo. F. Blake Mfg. Co., 91 Liberty St., New York.
A. S. Cameron Steam Pump Wks., E. 23d St., N. Y.
Davis Calyx Drill Co., 128 Broadway, New York.
Deane Steam Pump Co., Holyoke, Mass.
Eastwood Wire Mfg. Co., Belleville, N. J.
General Electric Co., New York.
Holly Mfg. Co., 120 Liberty St., New York.
Ingersoll-Sergeant Drill Co., 26 Cortlandt St., N. Y.
Jeffrey Mfg. Co., Columbus, Ohio.
Keystone Driller Co., Beaver Falls, Pa.
Knowles Steam Pump Wks., 91 Liberty St., N. Y.
Arthur Koppel, 68 Broad St., New York.
Laidlaw-Dunn-Gordon Co., Cincinnati, Ohio.
Lambert Hoisting Engine Co., Newark, N. J.
A. Leschen & Sons Rope Co., St. Louis, Mo.
Lidgerwood Mfg. Co., 96 Liberty St., New York.
John H. McGowan Co., Cincinnati, Ohio.
McKiernan Drill Co., 120 Liberty St., New York.
Monongahela Mfg. Co., Monongahela, Pa.
J. S. Mundy, Newark, N. J.
Norwalk Iron Works, South Norwalk, Conn.
Phillips Mine & Mill Supply Co., Pittsburg, Pa.
Pittsburgh Gage & Supply Co., Pittsburgh, Pa.
Providence Engineering Works, Providence, R. I.
Rand Drill Co., 128 Broadway, New York.
Robins Conveying Belt Co., 14-22 Park Row, N. Y.
F. L. Smidth & Co., 66 Maiden Lane, New York.
Snow Steam Pump Works, Buffalo, N. Y.
Trenton Iron Works Co., Trenton, N. J.

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Vulcan Iron Works Co., Toledo, Ohio.
Watt Mining Car Wheel Co., Barnesville, Ohio.
Webster, Camp & Lane Machine Co., Akron, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.
Henry R. Worthington, 120 Liberty St., New York.

### Mining Screens—*See Screens.*

### Motors, Electric.

American Engine Co., Bound Brook, N. J.
Bullock Electric Mfg. Co., Cincinnati, Ohio.
Chas. J. Bogue, 217 Centre St., New York.
C & C Electric Co., 145 Liberty St., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eddy Electric Mfg. Co., Windsor, Conn.
General Electric Co., New York.
Guarantee Electric Co., Chicago, Ill.
Jantz & Leist Electric Co., Cincinnati, Ohio.
Jeffrey Mfg. Co., Columbus, Ohio.
Schureman & Hayden, 137 So. Clinton St., Chicago, Ill.
Sprague Electric Co., 527 W. 34th St., New York.
B. F. Sturtevant Co., Jamaica Plain Station, Boston, Mass.
Triumph Electric Co., Cincinnati, Ohio.
Western Electric Company, Chicago, Ill.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

### Moulding Machines.

Tabor Mfg. Co., 1742 Hamilton St., Philadelphia, Pa.

### Multiple Spindle Drills.

Baush Machine Tool Co., Springfield, Mass.

### Naphtha Gas Machines.

American Gas Furnace Co., 23 John St., New York.

### Naphtha Launches

Gas Engine & Power Co., Morris Heights, N. Y.
Charles L. Seabury & Co., Morris Heights, N. Y.

### Nickel.

Orford Copper Co., 37 Wall St., New York.
Benedict & Burnham Mfg. Co., Waterbury, Conn.

### Nickel-Steel.

Bethlehem Steel Co., So. Bethlehem, Pa.

### Oil.

Keystone Lubricating Co., Philadelphia, Pa.
Thomas C. Warley, Philadelphia, Pa.

### Oil (Furnace) Burning Appliances.

Rockwell Engineering Co., 26 Cortlandt St., N. Y.

### Open Hearth Furnaces.

G. W. McClure, Son & Co., Smith Block, Pittsburg, Pa.

### Ore-Roasting Machinery.

Allis-Chalmers Co., Chicago, Ill.

### Packing.

Boston Belting Co., Boston, Mass.
Geo. B. Carpenter & Co., Chicago, Ill.
Jenkins Brothers, 71 John St., New York.
H. W. Johns Mfg. Co., 100 William St., New York.
Merwarth Metal Gasket Co., 107 Liberty St., N. Y.
Quaker City Rubber Co., Philadelphia, Pa.
Swain Lubricator Co., 252 Lake St., Chicago, Ill.

### Paints and Varnishes.

Detroit Graphite Mfg. Co., Detroit, Mich.
Joseph Dixon Crucible Co., Jersey City, N. J.
Harrison Bros. & Co., Inc., Philadelphia, Pa.
H. W. Johns Mfg. Co., 100 William St., New York.

### Paper-Mill Machinery.

Aultman Company, Canton, Ohio.
Geo. F. Blake Mfg. Co., 91 Liberty St., New York.
Deane Steam Pump Co., Holyoke, Mass.
Dodge Mfg. Co., Mishawaka, Ind.
Holly Mfg. Co., 120 Liberty St., New York.
Jeffrey Mfg. Co., Columbus, Ohio.
Knowles Steam Pump Wks., 91 Liberty St., N. Y.
Laidlaw-Dunn-Gordon Co., Cincinnati, Ohio.
Robins Conveying Belt Co., 14-22 Park Row, N. Y.
Snow Steam Pump Works, Buffalo, N. Y.
Henry R. Worthington, 120 Liberty St., New York.

### Patent Attorneys.

Wm. N. Cromwell, 1003 F St., N. W., Washington, D. C.
C. A. Dieterich, 229 Broadway, New York.
Victor J. Evans & Co., Evans Building, Washington, D. C.

### Pattern-Makers' Machinery.

J. A. Fay & Egan Co., 212-232 West Front St., Cincinnati, Ohio.
Pratt & Whitney Co., Hartford, Conn.

### Perforated Metal.

Allis-Chalmers Co., Chicago, Ill.
Robt. Aitchinson Perforated Metal Co., Chicago, Ill.
Hendrick Mfg. Co., Carbondale, Pa.

### Pipe, Cast-Iron.

Abendroth & Root Mfg. Co., 99 John St., New York.
Pittsburg Valve, Fdy. & Cons. Co., Pittsburg, Pa.
John Simmons Co., 110 Centre St., New York.
U. S. Cast Iron Pipe & Fdy. Co., Philadelphia, Pa.
Walworth Manufacturing Co., Boston, Mass.
R. D. Wood & Co., Philadelphia, Pa.

### Pipe Coverings.

H. W. Johns Mfg. Co., 100 William St., New York.
Michigan Pipe Co., Bay City, Mich.

### Pipe-Cutting and Threading Machines.

Armstrong Mfg. Co., Bridgeport, Conn.
Cox & Sons Company, Bridgeton, N. J.
Merrell Mfg. Co., Toledo, Ohio.
Niles Tool Works Co., Hamilton, Ohio.
Pratt & Whitney Co., Hartford, Conn.
John Simmons Co., 110 Centre St., New York.
Walworth Manufacturing Co., Boston, Mass.

### Pipe Fittings, Cast-Iron.

Abendroth & Root Mfg. Co., 99 John St., New York.
John Simmons Co., 110 Centre St., New York.
Walworth Manufacturing Co., Boston, Mass.

### Placer Testing Machinery.

Keystone Driller Co., Beaver Falls, Pa.

### Pipe Vises.

John Simmons Co., 110 Centre St., New York.
Standard Tool and Machine Co., Wilmington, Del.

### Planers.

American Tool Works Co., Cincinnati, Ohio.
Bement, Miles & Co., Philadelphia, Pa.
Hilles & Jones Co., Wilmington, Del.
Niles Tool Works Co., Hamilton, O.
Pond Machine Tool Co., Plainfield, N. J.
Pratt & Whitney Co., Hartford, Conn.
Wm. Sellers & Co., Inc., Philadelphia, Pa.
Whitcomb Mfg. Co., Worcester, Mass.
W. A. Wilson, Rochester, N. Y.

### Planing Mill Machinery.

J. A. Fay & Egan Co., 212-232 West Front St., Cincinnati, Ohio.

### Platinum Ware.

J. C. Entriken, Malvern, Pa.

### Pneumatic Concentrator.

General Concentrates Co., 128 Broadway, New York.

### Pneumatic Tools.

Clayton Air Compress. Wks., 26 Cortlandt St., N. Y.
A. J. Fisher, 50-56 So. Clinton St., Chicago, Ill.
Pedrick & Ayer Co., Philadelphia, Pa.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.

### Pop Safety Valves.

Ashton Valve Co., 271 Franklin St., Boston, Mass.
Consolidated Safety Valve Co., 85-89 Liberty St., New York.
Star Brass Mfg. Co., Boston, Mass.

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## Power Hammers.

H. G. Barr & Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Wm. Sellers & Co., Inc., Philadelphia, Pa.

## Power-Transmission Machinery.

Allis-Chalmers Co., Chicago, Ill.
Aultman Company, Canton, Ohio.
Geo. B. Carpenter & Co., Chicago, Ill.
Christiana Machine Co., Christiana, Pa.
Dodge Mfg. Co., Mishawaka, Ind.
General Electric Co., New York.
Jeffrey Mfg. Co., Columbus, Ohio.
A. Leschen & Sons Rope Co., St. Louis, Mo.
Link-Belt Eng'g Co., Nicetown, Philadelphia, Pa.
Niles Tool Works Co., New York, N. Y.
Robins Conveying Belt Co., 14-22 Park Row, N. Y.
S. Morgan Smith Co., York, Pa.
Sprague Electric Co., 527 W. 34th St., New York.
Stilwell-Bierce & Smith-Valle Co., Dayton, O.
Triumph Electric Co., Cincinnati, Ohio.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.
R. D. Wood & Co., Philadelphia, Pa.

## Presses and Dies.

Niagara Machine & Tool Works, Buffalo, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Watson & Stillman Co., 210 East 43d St., N. Y.
R. D. Wood & Co., Philadelphia, Pa.

## Prospecting Drills.

American Diamond Rock Drill Co., 120 Liberty St., New York.
American Well Works, Aurora, Ill.
Davis Calyx Drill Co., 128 Broadway, New York.
Keystone Driller Co., Beaver Falls, Pa.
Star Drilling Machine Co., Akron, Ohio.

## Pulleys, Shafting and Hangers.

Allis-Chalmers Co., Chicago, Ill.
American Tool & Machine Co., Boston, Mass
Aultman Company, Canton, Ohio.
Earle C. Bacon, 26 Cortlandt St., New York.
Christiana Machine Co., Christiana, Pa.
Dodge Mfg. Co., Mishawaka, Ind.
Jeffrey Mfg. Co., Columbus, Ohio.
Niles Tool Works Co., New York, N. Y.
R. Poole & Son Co., Baltimore, Md.
Robins Conveying Belt Co., 14-22 Park Row, N. Y.
Wm. Sellers & Co., Philadelphia, Pa.
S. Morgan Smith Co., York, Pa.
Stilwell-Bierce & Smith-Valle Co., Dayton, O.

## Pump Governors.

Power Specialty Co., 126 Liberty St., New York.

## Pumps and Pumping Machinery.

Allis-Chalmers Co., Chicago, Ill.
American Well Works, Aurora, Ill.
Ashcroft Mfg. Co., 85-89 Liberty St., New York.
Geo. F. Blake Mfg. Co., 91 Liberty St., N. Y.
Bucyrus Co., So. Milwaukee, Wis.
A. S. Cameron Steam Pump Wks., E. 23d St., N. Y
Geo. B. Carpenter & Co., Chicago, Ill.
Clayton Air Compress. Wks., 26 Cortlandt St., N.Y.
The Deane Steam Pump Co., of Holyoke, 140 Liberty St., New York.
Erie Pump & Engine Co., Erie, Pa
Flint & Walling Mfg. Co., Kendallville, Ind
Guild & Garrison, Brooklyn, N. Y.
Hall Steam Pump Co., Pittsburg, Pa.
Chas. L. Heisler, Erie, Pa.
The Holly Mfg. Co., 120 Liberty St., N. Y.
Ingersoll-Sergeant Drill Co., 26 Cortlandt St., N. Y
Kingsford Fdy. & Mch. Works, Oswego, N. Y.
Knowles Steam Pump Wks., 91 Liberty St., N. Y
The Laidlaw-Dunn-Gordon Co., 120 Liberty St., N.Y
John H. McGowan Co., Cincinnati, Ohio
Morris Machine Works, Baldwinsville, N. Y.
Pneumatic Eng'g Co., 128 Broadway, N. Y.
Providence Engineering Works, Providence, R. I.
Pulsometer Steam Pump Co., 135 Greenwich St., New York.
Wm. E. Quimby, 86 Liberty St., New York.
Rider-Ericsson Eng. Co., 24 Cortlandt St., N. Y.
Snow Steam Pump Works, 120 Liberty St., N. Y.
Stilwell-Bierce & Smith-Valle Co., Dayton, Ohio.
Webster, Camp & Lane Machine Co., Akron, Ohio.
R. D. Wood & Co., Philadelphia, Pa.
Henry R. Worthington, 120 Liberty St., New York.

## Pump Valves.

Boston Belting Co., Boston, Mass.
Power Specialty Co., 126 Liberty St., New York.

## Punching and Shearing Machinery.

American Tool Works Co., Cincinnati, Ohio.
Bethlehem Foundry & Mch. Co., So. Bethlehem, Pa.
Hilles & Jones Co., Wilmington, Del.
Morgan Construction Co., Worcester, Mass.
Niagara Machine & Tool Works, Buffalo, N. Y.
Niles Tool Works Co., Hamilton, O.
Pond Machine Tool Co., Plainfield, N. J.
Pratt & Whitney Co., Hartford, Conn.
Wm. Sellers & Co., Inc., Philadelphia, Pa.
Standard Tool and Machine Co., Wilmington, Del.
W. C. Young Mfg. Co., Worcester, Mass.

## Pyrometers.

Charles Engelhard, 41 Cortlandt St., New York.

## Quarrying Machinery.

A. S. Cameron Steam Pump Wks., E. 23d St., N. Y.
Cooper, Hewitt & Co., 17 Burling Slip, New York.
Ingersoll-Sergeant Drill Co., 26 Cortlandt St., N. Y.
John H. McGowan Co., Cincinnati, Ohio.
Rand Drill Co., 128 Broadway, New York.
Robins Conveying Belt Co., 14-22 Park Row, N. Y.
Trenton Iron Co., Trenton, N. J.
Vulcan Iron Works Co., Toledo, Ohio.

## Radiators.

A. A. Griffing Iron Co., 66-68 Centre St., New York; Works, Jersey City, N. J.
Michigan Brass & Iron Works, Detroit, Mich.
John Simmons Co., 110 Centre St., New York.
H. B. Smith Co., 137 Centre St., New York.

## Railway Shop Machinery.

Chester B. Albree, Allegheny, Pa.
Armstrong Mfg. Co., Bridgeport, Conn.
W. F. & John Barnes Co., Rockford, Ill.
Bickford Drill & Tool Co., Cincinnati, Ohio.
J. A. Fay & Egan Co., 212-232 West Front St., Cincinnati, Ohio.
Gould & Eberhardt, Newark, N. J.
Grant Tool Co., Franklin, Pa.
Hilles & Jones Co., Wilmington, Del.
Niles Tool Works, Hamilton, Ohio.
Norwalk Iron Works, South Norwalk, Conn.
Pedrick & Ayer Co., Philadelphia, Pa.
Pond Machine Tool Co., Plainfield, N. J.
Pratt & Whitney Co., Hartford, Conn.
Stow Flexible Shaft Co., Philadelphia, Pa.
Stow Manufacturing Co., Binghamton, N. Y.
Watson & Stillman Co., 210 E. 43d St., New York.

## Railway Specialties.

Geo. B. Carpenter & Co., Chicago, Ill.
Goodwin Car Co., 96 Fifth Ave., New York.
H. W. Johns Mfg. Co., 100 William St., New York.
Arthur Koppel, 68 Broad St., New York.
Maryland Steel Co., Sparrows Point, Md.
Pennsylvania Steel Co., Steelton, Pa.
Pittsburgh Gage & Supply Co., Pittsburgh, Pa.
H. K. Porter & Co., Pittsburg, Pa.
Pratt & Whitney Co., Hartford, Conn.
Sprague Electric Co., 527 W. 34th St., New York.
Star Brass Mfg. Co., Boston, Mass.
Vulcan Iron Works Co., Toledo, Ohio.
Westinghouse Air Brake Co., Pittsburg, Pa.

## Refrigerating Machinery—*See Ice-Making Machinery.*

## Riveting Machines.

Chester B. Albree, Allegheny, Pa.
Bethlehem Fdy. & Mch. Co., So. Bethlehem, Pa.
A. J. Fisher, 50-56 So. Clinton St., Chicago, Ill.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Niles Tool Works Co., Hamilton, Ohio.
Pedrick & Ayer Co., Philadelphia, Pa.
Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Wm. Sellers & Co., Inc., Philadelphia, Pa.
R. D. Wood & Co., Philadelphia, Pa.

## Road-Making Machinery.

Aultman Co., Canton, Ohio.
Earle C. Bacon, 26 Cortlandt St., New York.
Marion Steam Shovel Co., Marion, Ohio.
Vulcan Iron Works, Toledo, Ohio.

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### Rock Breakers.

Allis-Chalmers Co., Chicago, Ill.
Aultman Co., Canton, Ohio.
Robins Conveying Belt Co., 14-22 Park Row, N. Y.
F. L. Smidth & Co., 66 Malden Lane, New York.
Sturtevant Mill Co., Boston, Mass.

### Roofing.

H. W. Johns Mfg. Co., 100 William St., New York.
Passaic Rolling Mill Co., Paterson, N. J.
Warren Chemical & Mfg. Co., 81 Fulton St., N. Y.

### Rope Transmission.

American Mfg. Co., 63 Wall St., New York.
Aultman Company, Canton, Ohio.
Broderick & Bascom Rope Co., St. Louis, Mo.
Geo. B. Carpenter & Co., Chicago, Ill.
Crocker-Wheeler Co., Ampere, N. J.
Dodge Mfg. Co., Mishawaka, Ind.
Durable Wire Rope Co., Boston, Mass.
C. W. Hunt Co., West New Brighton, New York.
Jeffrey Mfg. Co., Columbus, Ohio.
A. Leschen & Sons Rope Co., St. Louis, Mo.
Link-Belt Eng'g Co., Nicetown, Philadelphia, Pa.
Providence Engineering Works, Providence, R. I.
S. Morgan Smith Co., York, Pa.

### Rubber Goods.

Boston Belting Co., Boston, Mass.
Geo. B. Carpenter & Co., Chicago, Ill.
Jenkins Bros., 71 John St., New York.
Quaker City Rubber Co., Philadelphia, Pa.

### Sand Mixers and Sifters.

Gould & Eberhardt, Newark, N. J.

### Saw-Mill Machinery.

Allis-Chalmers Co., Chicago, Ill.
Chandler & Taylor Co., Indianapolis, Ind.
J. A. Fay & Egan Co., 212-232 West Front St., Cincinnati, Ohio.
Jeffrey Mfg. Co., Columbus, Ohio.

### Schools.

Clarkson School of Technology, Potsdam, N. Y.
The Consolidated Schools, 156 Fifth Ave., N. Y.
International Correspondence Schools, Scranton, Pa.
Lehigh University, So. Bethlehem, Pa.
Lafayette College, Easton, Pa.
Mass. Institute of Technology, Boston, Mass.
McGill University, Montreal.
Michigan College of Mines, Houghton, Mich.
New York Military Academy, Cornwall, N. Y.
Pratt Institute, Brooklyn, N. Y.
Rensselaer Polytechnic Institute, Troy, N. Y.
Rose Polytechnic Institute, Terre Haute, Ind.
Sheffield Scientific School of Yale University, New Haven, Conn.
Stevens Institute of Technology, Hoboken, N. J.
Thayer School of Civil Engineering, Hanover, N. H.
University of Kansas, Lawrence, Kan.
University of Tennessee, Knoxville, Tenn.
University of Wisconsin, Madison, Wis.
Worcester Polytechnic Institute, Worcester, Mass.

### Screens, Mining.

Robert Aitchison Perforated Metal Co., Chicago, Ill.
Allis-Chalmers Co., Chicago, Ill.
Aultman Company, Canton, Ohio.
Earle C. Bacon, 26 Cortlandt St., New York.
Eastwood Wire Mfg. Co., Belleville, N. J
Hendrick Mfg. Co., Ltd., Carbondale, Pa.
Jeffrey Mfg. Co., Columbus, Ohio.
Monongahela Mfg. Co., Monongahela, Pa.
Robins Conveying Belt Co., 14-22 Park Row, N. Y.

### Screw Machines.

American Tool Works Co., Cincinnati, Ohio.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Jones & Lamson Machine Co., Springfield, Vt.
Niles Tool Works, Hamilton, Ohio.
Pearson Machine Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

### Search Lights and Projectors.

Chas. J. Bogue, 217 Centre St., New York.

### Separators, Steam and Oil.

Allis-Chalmers Co., Chicago, Ill.
Austin Separator Co., Detroit, Mich.
Earle C. Bacon, 26 Cortlandt St., New York.
John Davis Co., 51-79 Michigan St., Chicago, Ill.
Direct Separator Co., Syracuse, N. Y.
Goubert Mfg. Co., 85 Liberty St., New York.
A. A. Griffing Iron Co., 66-68 Centre St., New York; Works, Jersey City.
Harrison Safety Boiler Works, Philadelphia, Pa.
Watson & McDaniel Co., Philadelphia, Pa.

### Shafting—*See Pulleys.*

### Shapers.

American Tool Works Co., Cincinnati, Ohio.
Gould & Eberhardt, Newark, N. J.
Niles Tool Works Co., Hamilton, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Wm. Sellers & Co., Inc., Philadelphia, Pa.

### Shears—See Punching Machinery.

### Skylights (Steel Puttyless).

National Skylight & Construction Co., 120 Liberty St., New York.

### Special Machinery.

American Ordnance Co., Bridgeport, Conn.
H. G. Barr & Co., Worcester, Mass.

### Spiral Riveted Pipe.

Abendroth & Root Mfg. Co., 99 John St., New York.

### Steam-Regulating Appliances.

Ashcroft Mfg. Co., 85-89 Liberty St., New York.
Crane Co., Chicago, Ill.
Julian D'Este Co., 24 Canal St., Boston, Mass.
Harrison Safety Boiler Works, Philadelphia, Pa.
Jenkins Brothers, 71 John St., New York.
The Lunkenheimer Co., Cincinnati, Ohio.
Pittsburg Valve, Fdy. & Cons. Co., Pittsburg, Pa.
John Simmons Co., 110 Centre St., New York.
Walworth Manufacturing Co., Boston, Mass.
Watson & McDaniel Co., Philadelphia, Pa.
Williams Gauge Co., W. Pittsburg, Pa.

### Steam Pile Hammers.

A. F. Bartlett & Co., Saginaw, Mich.

### Steam Shovels.

The Bucyrus Co., So. Milwaukee, Wis.
Vulcan Iron Works Co., Toledo, Ohio.

### Steam Specialties.

Ashcroft Mfg. Co., 85-89 Liberty St., New York.
Crane Co., Chicago, Ill.
John Davis Co., 51-79 Michigan St., Chicago, Ill.
The Lunkenheimer Co., Cincinnati, O.
Michigan Brass & Iron Works, Detroit, Mich.
Pittsburgh Gauge & Supply Co., Pittsburgh, Pa.
John Simmons Co., 110 Centre St., New York.
Walworth Mfg. Co., Boston, Mass.
Watson & McDaniel Co., Philadelphia, Pa.
Wm. H. Wilkinson & Co., 352 Atlantic Ave., Boston, Mass.

### Steam Superheaters.

Power Specialty Co., 126 Liberty St., New York.
Providence Engineering Works, Providence, R. I.

### Steam Traps.

American Blower Co., Detroit, Mich.
Eureka Iron Co., 59-61 So. Canal St., Chicago, Ill.
Buffalo Forge Co., Buffalo, N. Y.
A. A. Griffing Iron Co., 66-68 Centre St., New York; Works, Jersey City, N. J.
John Simmons Co., 110 Centre St., New York.
B. F. Sturtevant Co., Jamaica Plain Station, Boston, Mass.
Walworth Manufacturing Co., Boston, Mass.
Watson & McDaniel Co., Philadelphia, Pa.

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### Steam Yachts.

Gas Engine & Power Co., Morris Heights, N. Y.
Charles L. Seabury & Co., Morris Heights, N. Y.

### Steel.

Bethlehem Steel Co., So. Bethlehem, Pa.
Wm. Jessop & Sons, Ltd., 91 John St., New York.
Latrobe Steel Co., Philadelphia, Pa.
Maryland Steel Co., Sparrows Point, Md.
Passaic Rolling Mill Co., Paterson, N. J.
Pennsylvania Steel Co., Steelton, Pa.
Walworth Manufacturing Co., Boston, Mass.

### Steel Flanges.

Latrobe Steel Co., Philadelphia, Pa.

### Stokers—Mechanical.

American Stoker Co., 11 Broadway, New York.
Babcock & Wilcox Co., 85 Liberty St., New York.
Wm. Sellers & Co., Inc., Philadelphia, Pa.
Westinghouse Machine Co., Pittsburg, Pa.
Westinghouse, Church, Kerr & Co., 26 Cortlandt St., New York.

### Storage Batteries.

Electric Storage Battery Co., Philadelphia, Pa.

### Structural Iron Work.

Chester B. Albree, Allegheny, Pa.
American Bridge Co., 100 Broadway, New York.
Browning Engineering Co., Cleveland, Ohio.
Passaic Rolling Mill Co., Paterson, N. J.
Riter-Conley Mfg. Co., Pittsburg, Pa.

### Sugar-House Machinery.

American Tool & Machine Co., Boston, Mass.
Eastwood Wire Mfg. Co., Belleville, N. J.
Jeffrey Manufacturing Co., Columbus, Ohio.
Link-Belt Eng'g Co., Nicetown, Philadelphia, Pa.
Robins Conveying Belt Co., 14-22 Park Row, N. Y.
R. D. Wood & Co., Philadelphia, Pa.

### Tanks, Iron.

Allis-Chalmers Co., Chicago, Ill.
Atlantic Works, East Boston, Mass.
Aultman Company, Canton, Ohio.
L. O. Koven & Brother, 50 Cliff St., New York.
Pittsburg Locomotive Works, Pittsburg, Pa.
Riter-Conley Mfg. Co., Pittsburg, Pa.
S. Morgan Smith Co., York, Pa.

### Tanks, Wood.

W. E. Caldwell Co., Louisville, Ky.

### Tapping and Reaming Machines.

Philadelphia Pneumatic Tool Co., Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Stow Flexible Shaft Co., Philadelphia, Pa.

### Telephones.

Ericsson Telephone Co., 296 Broadway, New York

### Tenoning Machines.

J. A. Fay & Egan Co., 212-232 West Front St., Cincinnati, Ohio.

### Thermometers.

Bristol Co., Waterbury, Conn.
Charles Engelhard, 41 Cortlandt St., New York.
Queen & Co., Inc., Philadelphia, Pa.

### Tires—Steel.

Latrobe Steel Co., Philadelphia, Pa.

### Traveling Cranes.

Pawling Harnischfeger, Milwaukee, Wis.
Shaw Electric Crane Co., Muskegon, Mich.

### Turbine Water-Wheels.

Christiana Machine Co., Christiana, Pa.
James Leffel & Co., Springfield, Ohio.
Pelton Water Wheel Co., San Francisco, Cal.
R. Poole & Son Co. Baltimore, Md.
S. Morgan Smith Co., York, Pa.
Stilwell-Bierce & Smith-Vaile Co., Dayton, Ohio
R. D. Wood & Co., Philadelphia, Pa.

### Turnbuckles.

Geo. B. Carpenter & Co., Chicago, Ill.
Merrill Bros., 475 Kent Ave., Brooklyn, N. Y.
John Simmons Co., 110 Centre St., New York.

### Turn Tables.

Dodge Mfg. Co., Mishawaka, Ind.
Arthur Koppel, 68 Broad St., New York.
Passaic Rolling Mills Co., Paterson, N. J.
Wm. Sellers & Co., Philadelphia, Pa.

### Turret Lathes.

Niles Tool Works Co., Hamilton, Ohio.
Pearson Machine Co., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.

### Typewriters.

Elliott & Hatch Book Typewriter Co., 256 Broadway, New York.
Wyckoff, Seamans & Benedict, New York.

### Vacuum Gauges.

Hohmann & Maurer Mfg. Co., Rochester, N. Y.

### Vacuum Pumps.

A. S. Cameron Steam Pump Wks., E. 23d St., N. Y.
Clayton Air-Compress. Wks., 26 Cortlandt St., N. Y.
Deane Steam Pump Co., Holyoke, Mass.
Guild & Garrison, Brooklyn, N. Y.
John H. McGowan Co., Cleveland, Ohio.
Pearson Machine Co., Chicago, Ill.
Stilwell-Bierce & Smith-Vaile Co., Dayton, O.

### Valve Handles.

Troy Nickel Works, Albany, N. Y.

### Valves—Gas, Steam, and Water.

Ashton Valve Co., 271 Franklin St., Boston, Mass.
Consolidated Safety Valve Co., 85-89 Liberty St., New York.
Crane Co., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
John Davis Co., 51-79 Michigan St., Chicago, Ill.
Eastwood Wire Mfg. Co., Belleville, N. J.
Jenkins Bros., 71 John St., New York.
Kennedy Valve Mfg. Co., 70 Beekman St., N. Y.
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John H. McGowan Co., Cincinnati, Ohio.
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### Ventilating Appliances—*See Heating and Ventilating.*

### Wage Calculators.

Carlton Mfg. Co., Carlton Hills, N. J.

### Watchman's Time Detectors.

American Watchmen's Time Detector Co., 234 & 235 Broadway, New York.
Ashcroft Mfg. Co., 85-89 Liberty St., New York.
E. Howard Clock Co., 395 Washington St., Boston, Mass., 43 Maiden Lane, New York.

### Water-Closets.

Kenney Company, 72-74 Trinity Place, N. Y.,
John Simmons Co., 110 Centre St., New York.

### Water Lifts.

American Well Works, Aurora, Ill.
Clayton Air Compress. Wks., 26 Cortlandt St., N.Y.
Hall Steam Pump Co., Pittsburg, Pa.
Ingersoll-Sergeant Drill Co., 26 Cortlandt St., N. Y.
Pneumatic Engineering Co., 128 B'way, N. Y.

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### Water Meters.

Builders' Iron Foundry, Providence, R. I.
John Simmons Co., 110 Centre St., New York.
Standard Water Meter Co., 22-26 Reade St., N. Y.

### Water Motors.

Standard Water Meter Co., 22-26 Reade St., N. Y.

### Water Tube Boilers.

Abendroth & Root Mfg. C., 99 John St., New York.
Babcock & Wilcox Co., 85 Liberty St., New York.
Gas Engine & Power Co., Morris Heights, N. Y.
Hammond Iron Works, Warren, Pa.
Charles L. Seabury & Co., Morris Heights, N. Y.

### Water-Works Pumping Machinery.

Allis-Chalmers Co., Chicago, Ill.
Geo. F. Blake Mfg. Co., 91 Liberty St., New York.
Deane Steam Pump Co., Holyoke, Mass.
Holly Mfg. Co., 120 Liberty St., New York.
Keystone Driller Co., Beaver Falls, Pa.
Knowles Steam Pump Wks., 91 Liberty St., N. Y.
Laidlaw-Dunn-Gordon Co., Cincinnati, Ohio.
Snow Steam Pump Works, Buffalo, N. Y.
Stilwell-Bierce & Smith-Vaile Co., Dayton, O.
R. D. Wood & Co., Philadelphia, Pa.
Henry R. Worthington, 120 Liberty St., New York.

### Water-Works Supplies.

American Well Works, Aurora, Ill.
W. E. Caldwell Co., Louisville, Ky.
John Simmons Co., 110 Centre St., New York.
Star Drilling Machine Co., Akron, Ohio.
U. S. Cast Iron Pipe & Foundry Co., Phila., Pa.
R. D. Wood & Co., Philadelphia, Pa.

### Well-Sinking and Prospecting Machinery.

American Diamond Rock Drill Co., 120 Liberty St., New York.
American Well Works, Aurora, Ill.
Keystone Driller Co., Beaver Falls, Pa.
Star Drilling Machine Co., Akron, Ohio.
St. Louis Well Machine & Tool Co., St. Louis, Mo.
Williams Bros., Ithaca, N. Y.

### Well Supplies.

Keystone Driller Co., Beaver Falls, Pa.
John Simmons Co., 110 Centre St., New York.
St. Louis Well Machine & Tool Co., St. Louis, Mo.

### Wind Mills

W. E. Caldwell Co., Louisville, Ky.
Flint & Walling Mfg. Co., Kendallville, Ind.

### Wire, Copper.

Bridgeport Brass Co., 19 Murray St., New York.

### Wire-Drawing Machinery.

Morgan Construction Co., Worcester, Mass.

### Wire, Insulated—*See Insulated Wire.*

### Wire Rope.

Broderick & Bascom Rope Co., St. Louis, Mo.
Geo. B. Carpenter & Co., Chicago, Ill.
Cooper, Hewitt & Co., 17 Burling Slip, New York.
Durable Wire Rope Co., Boston, Mass.
Hazard Mfg. Co., Wilkes-Barre, Pa.
Jeffrey Mfg. Co., Columbus, Ohio.
A. Leschen & Sons Rope Co., St. Louis, Mo.
Phosphor Bronze Smelt. Co., Ltd., Philadelphia, Pa.
John A. Roebling's Sons Co., Trenton, N. J.
Trenton Iron Co., Trenton, N. J.

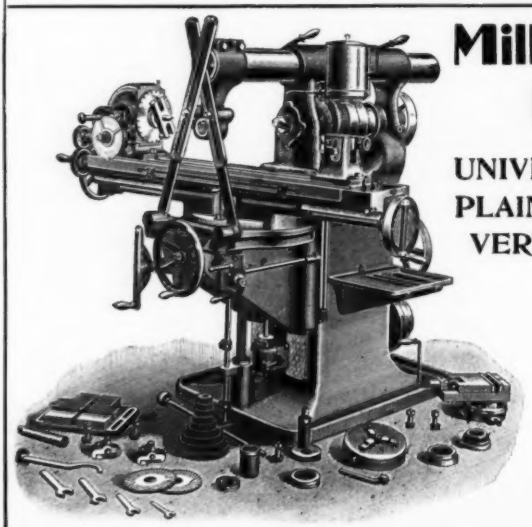
### Wood-Working Machinery.

J. A. Fay & Egan Co., 212-232 West Front St., Cincinnati, Ohio.
H. B. Smith Machine Co., Smithville, N. J.
Stow Flexible Shaft Co., Philadelphia, Pa.

### Wrenches.

Coes Wrench Co., Worcester, Mass.
John Simmons Co., 110 Centre St., New York.


Brown & Sharpe Mfg. Co., PROVIDENCE, R. I. U. S. A.



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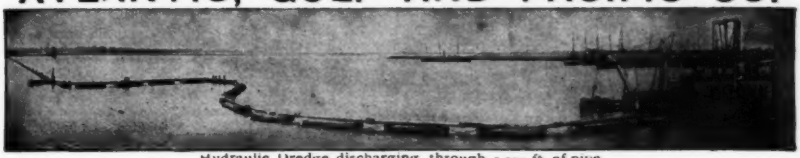

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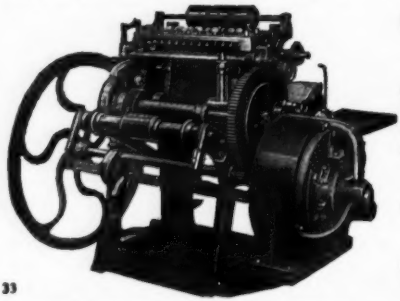

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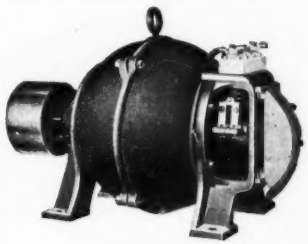

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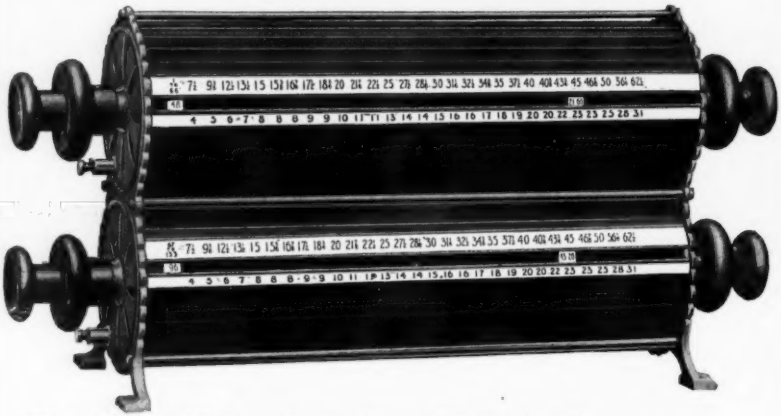

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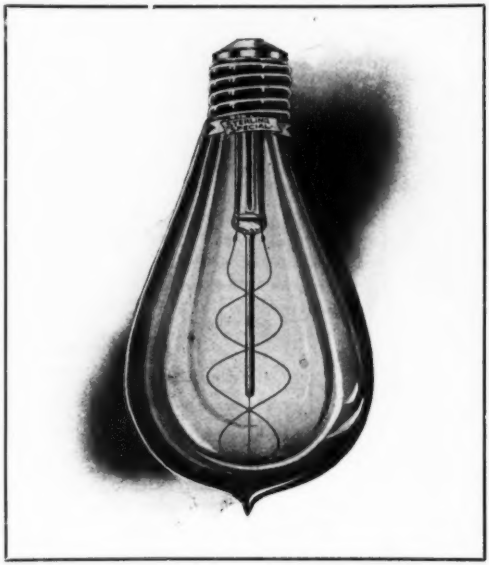

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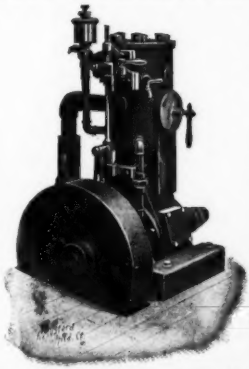

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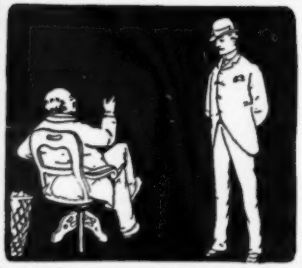

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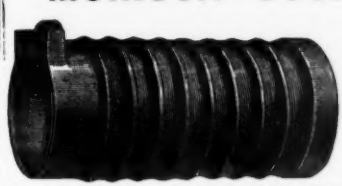

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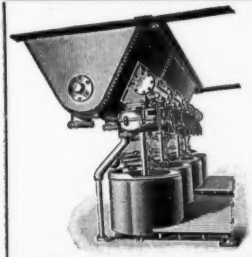

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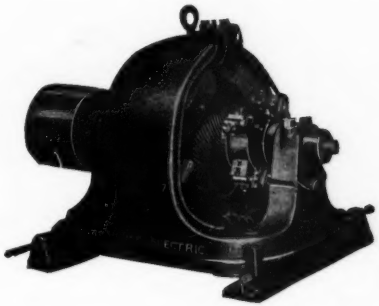

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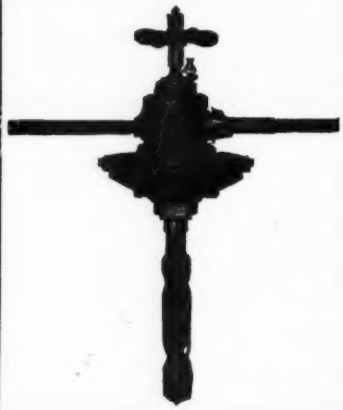

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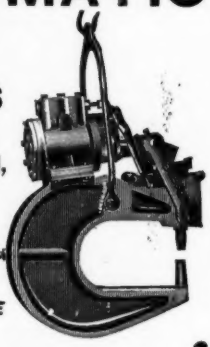

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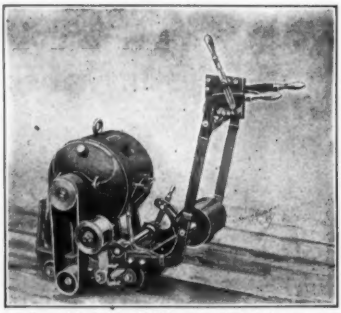

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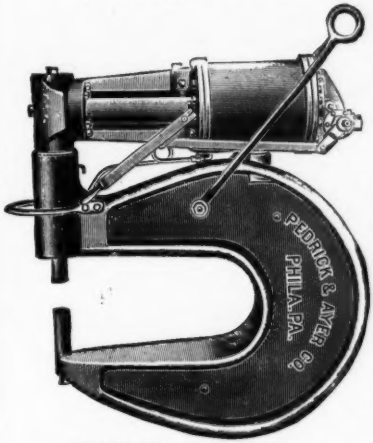


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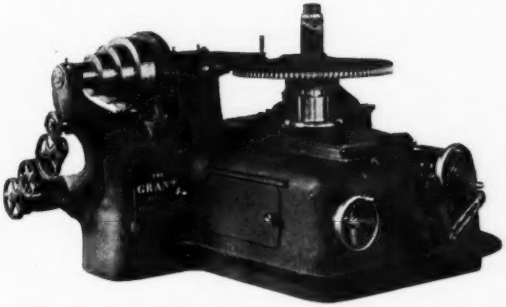

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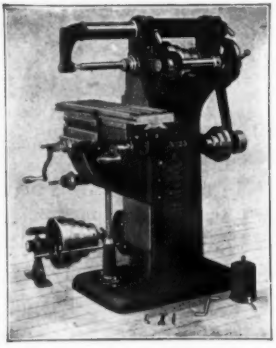

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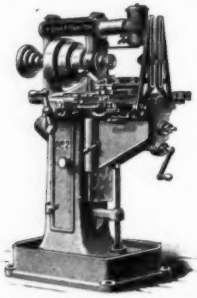

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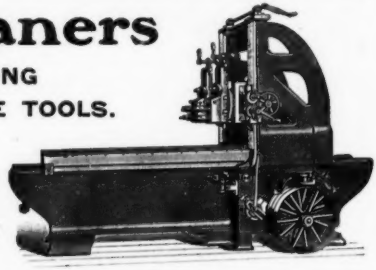

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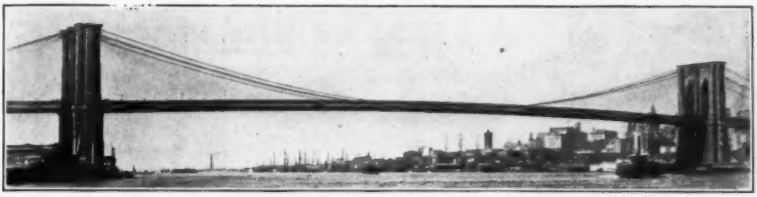

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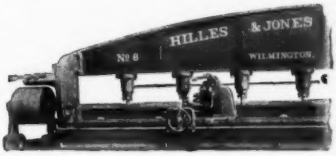


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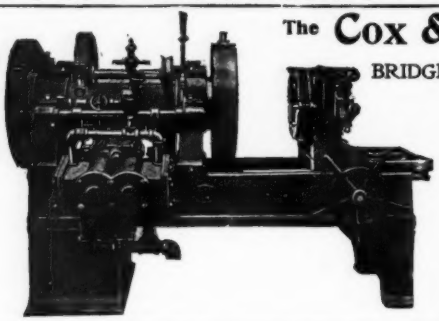

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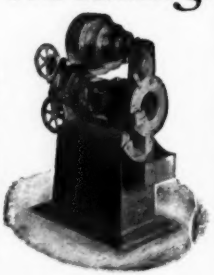

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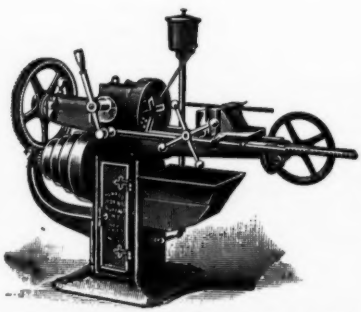

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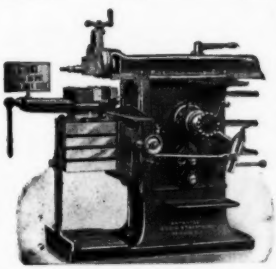

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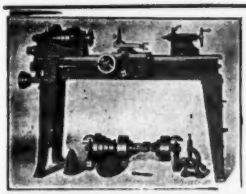

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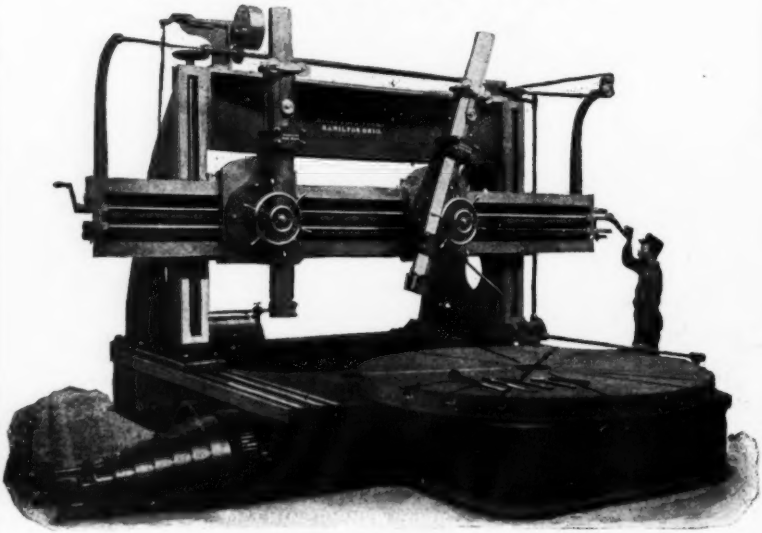

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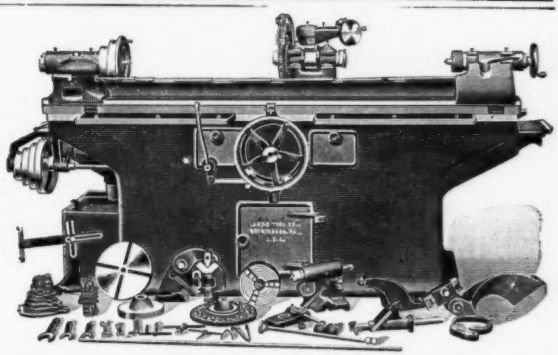

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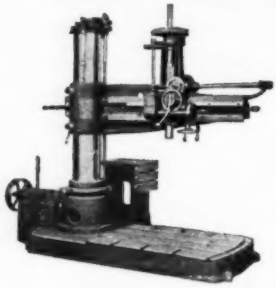

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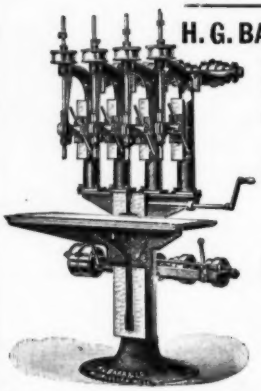

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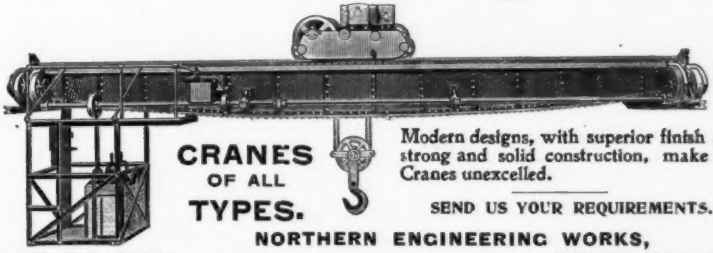

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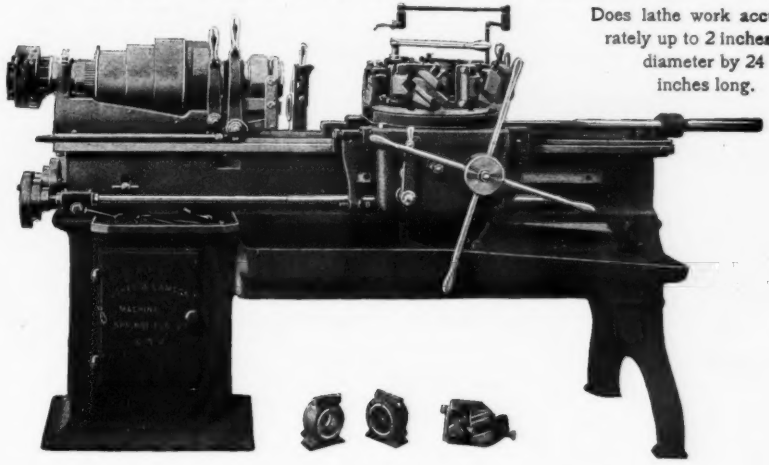

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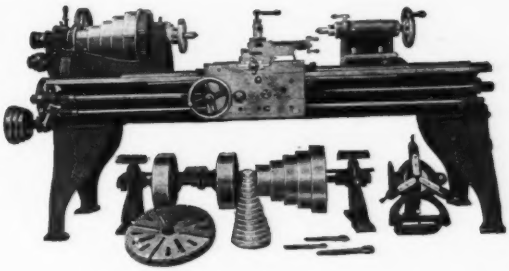

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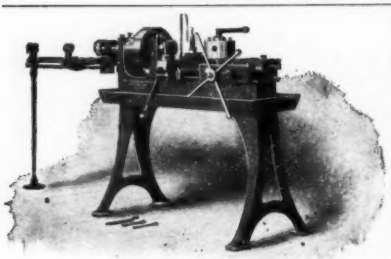

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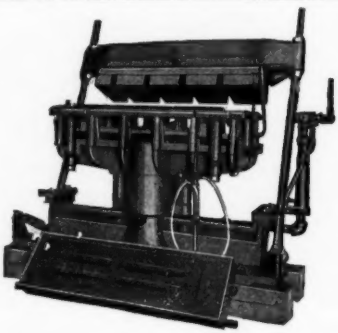

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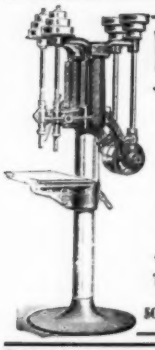

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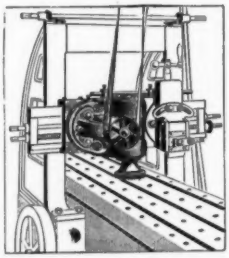

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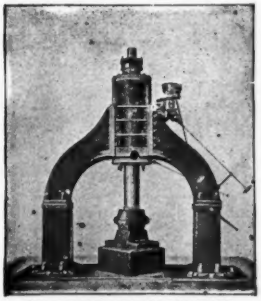

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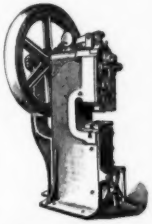

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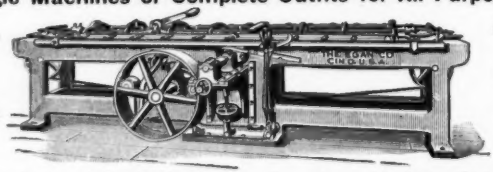

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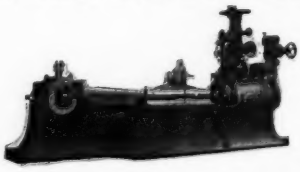

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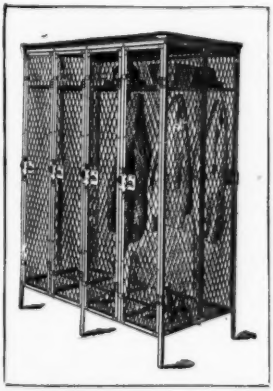

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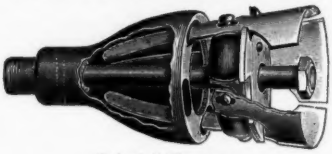

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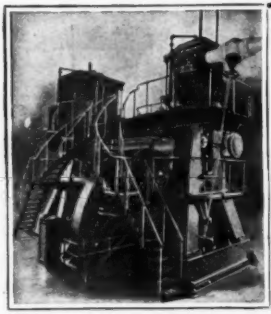

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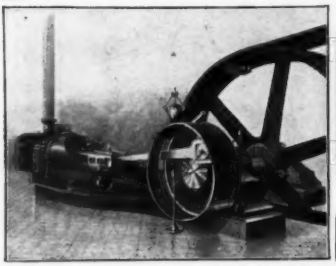

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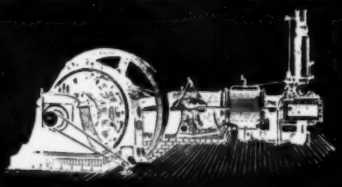

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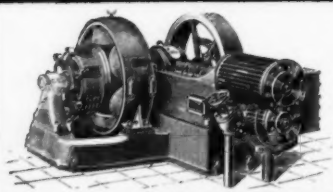

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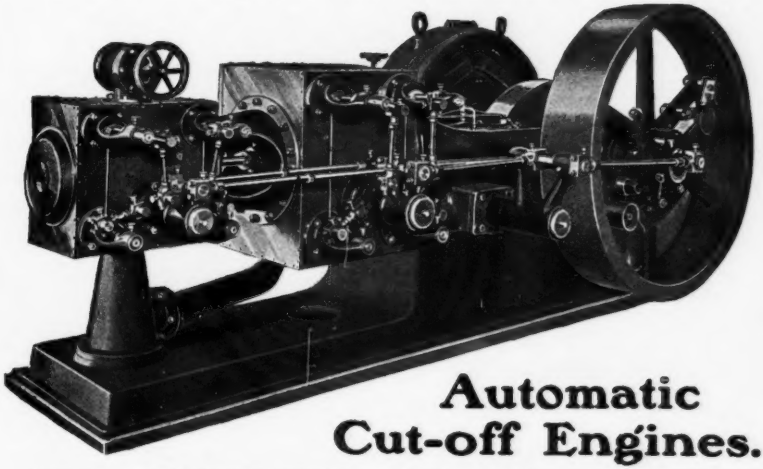

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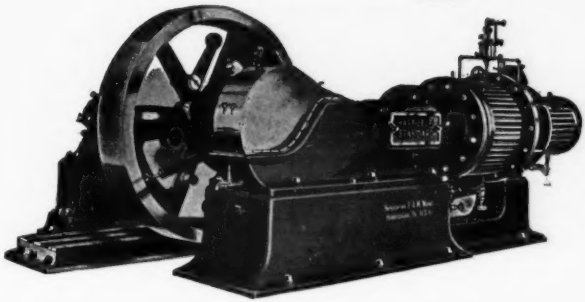

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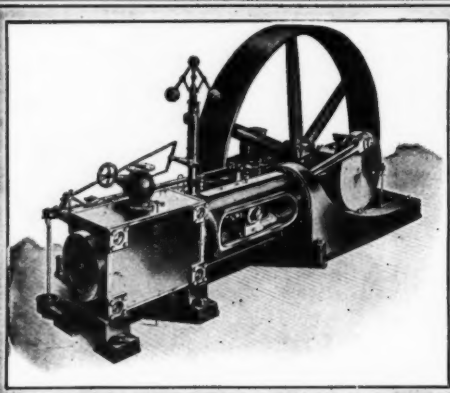

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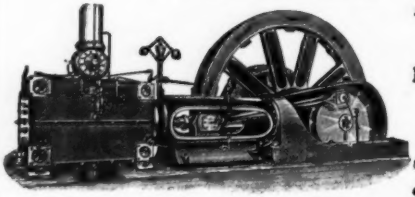

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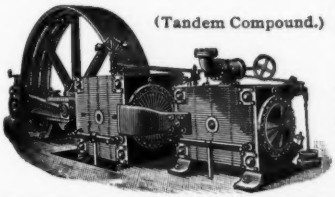

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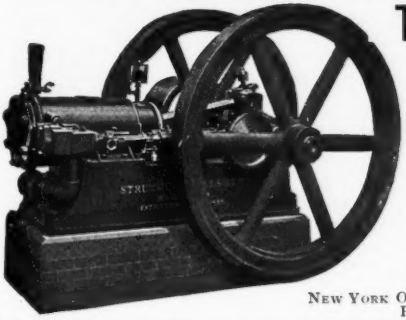

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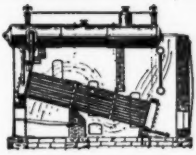

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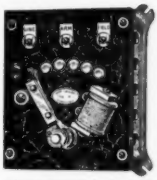

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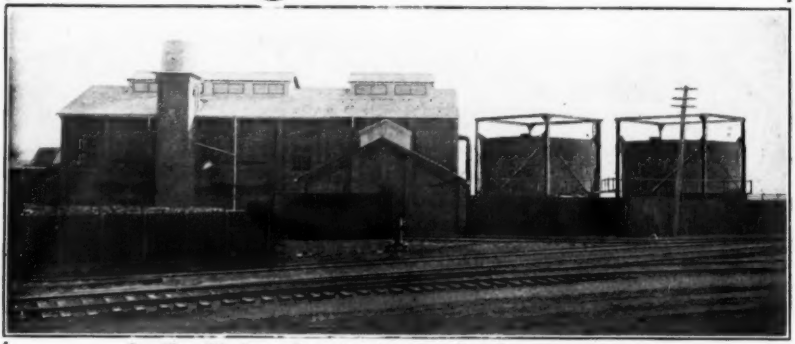

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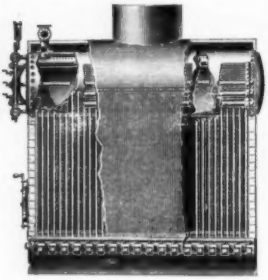

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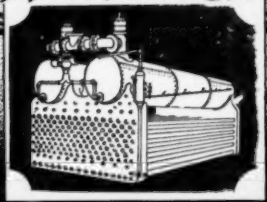

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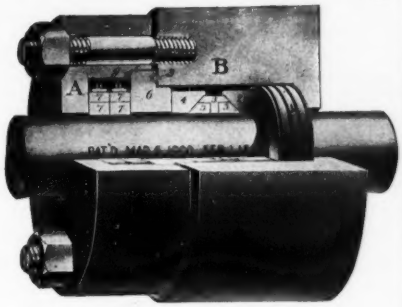


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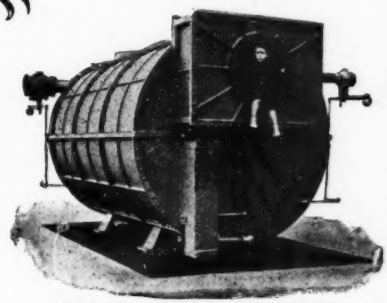

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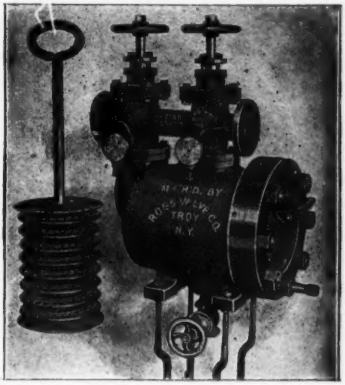

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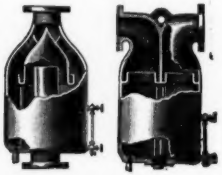

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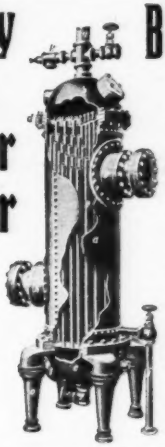

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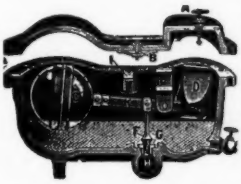

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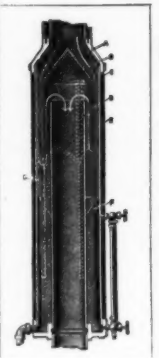

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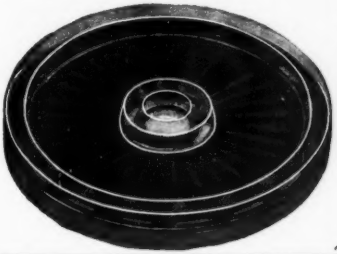

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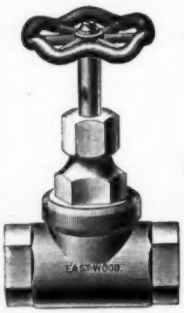


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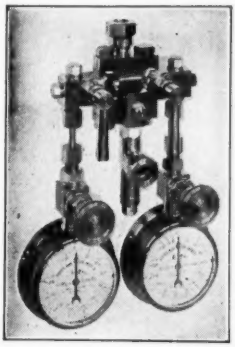

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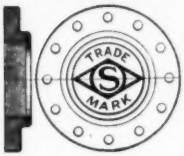


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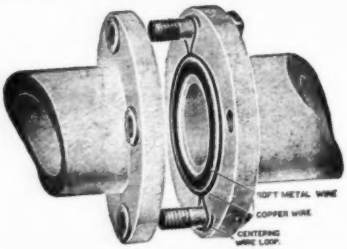


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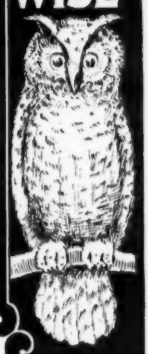

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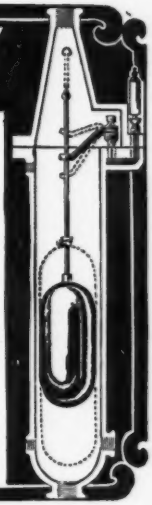

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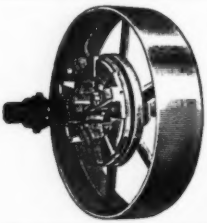

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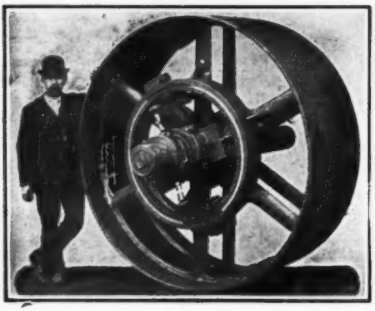

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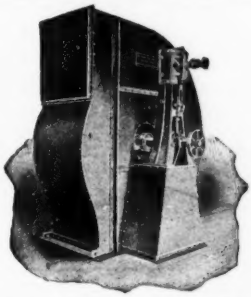

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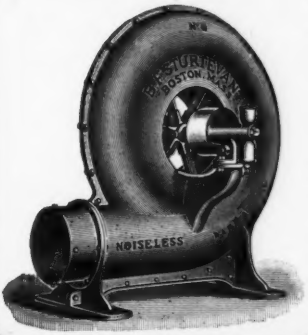


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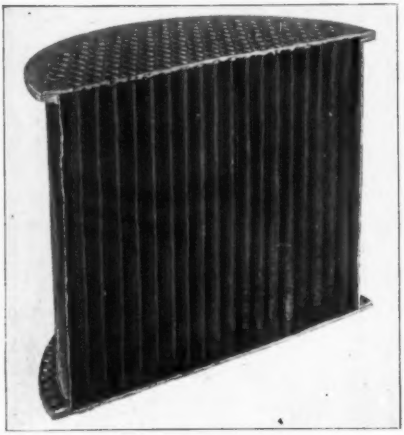

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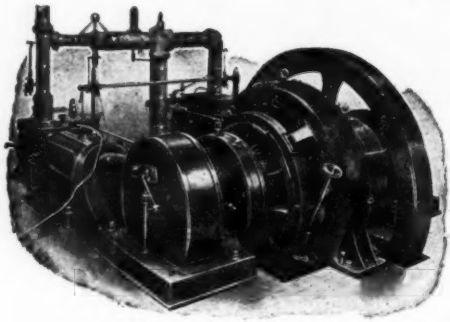

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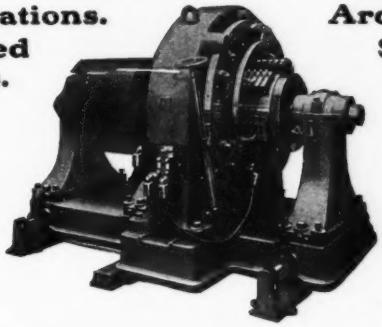

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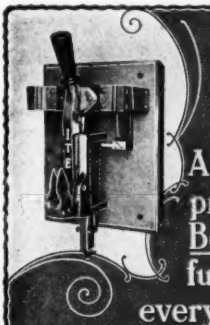

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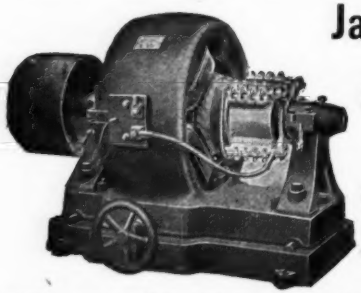

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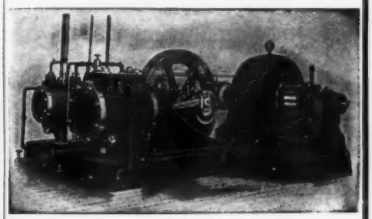

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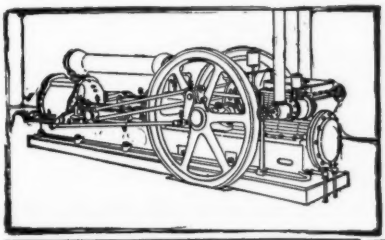

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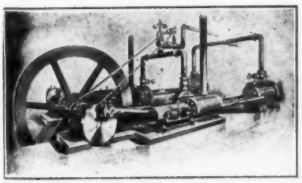

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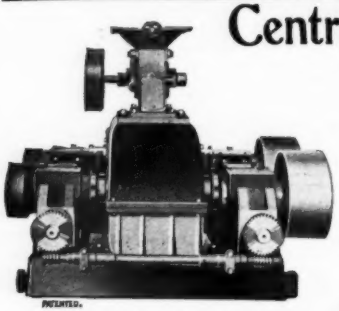

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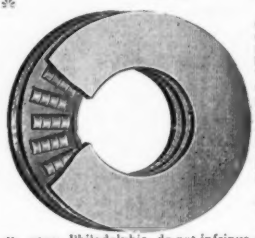

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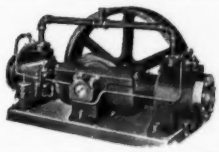

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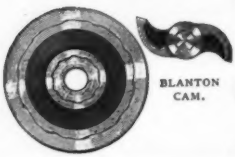

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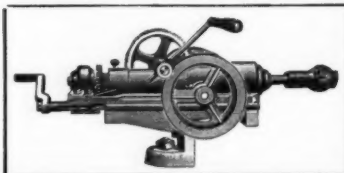

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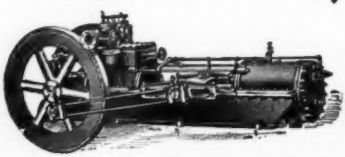

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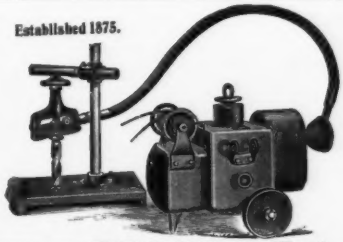

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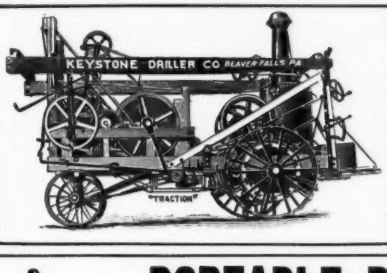


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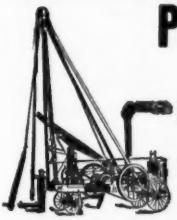

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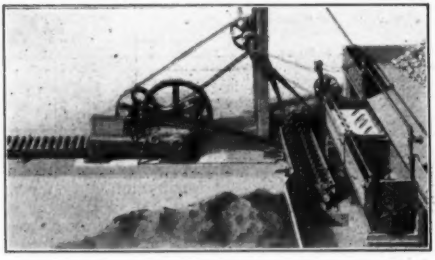

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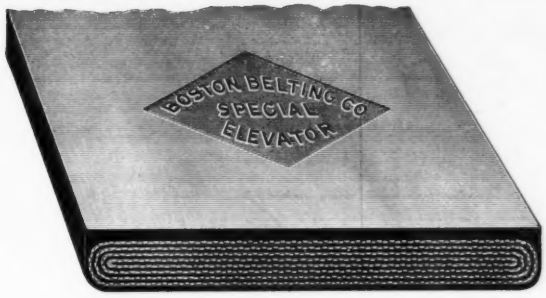


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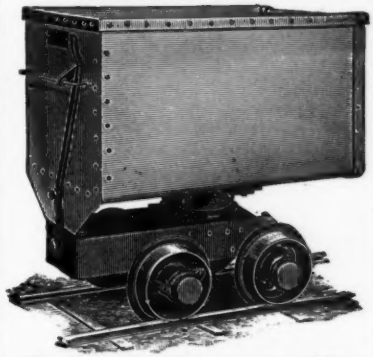

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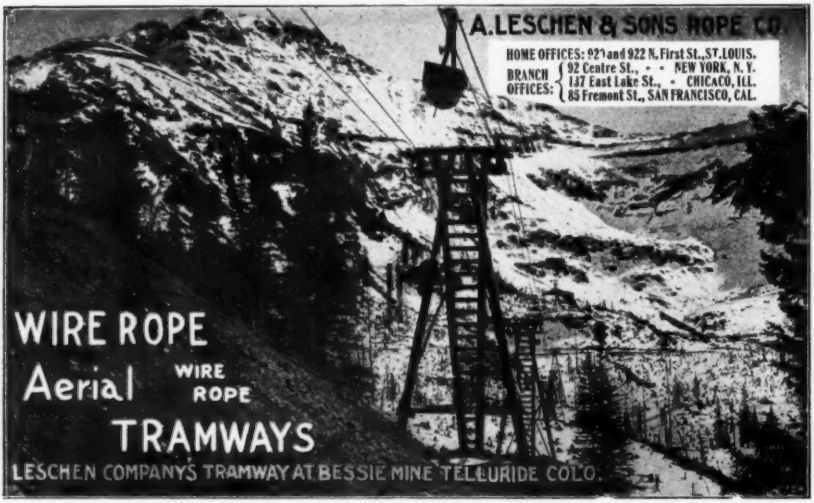
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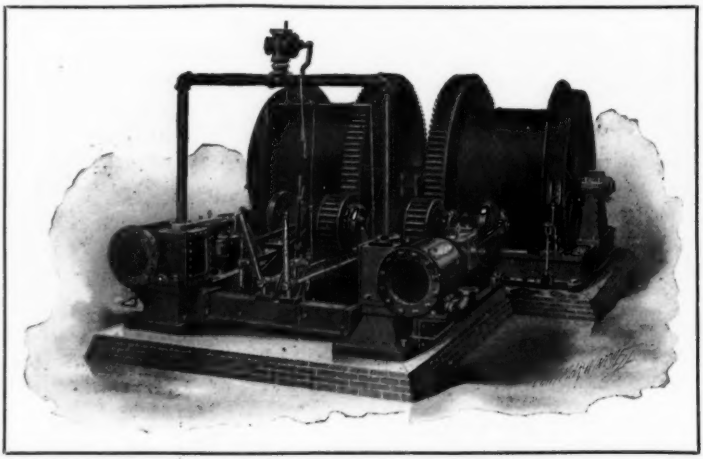

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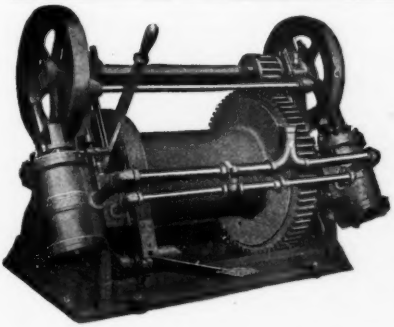

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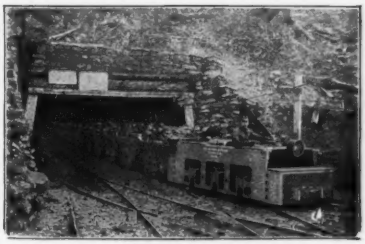

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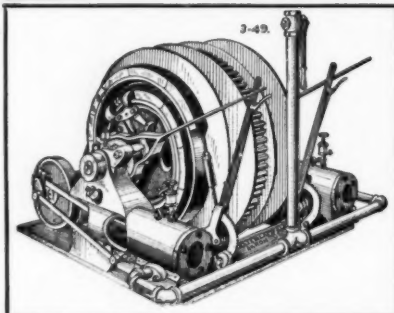

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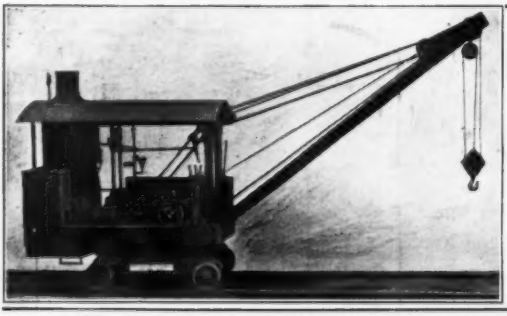

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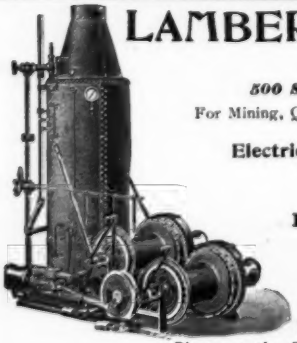

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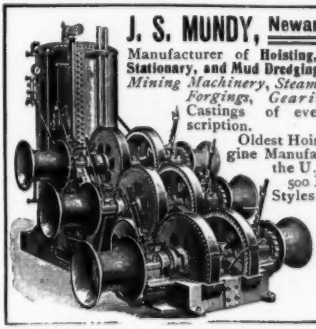

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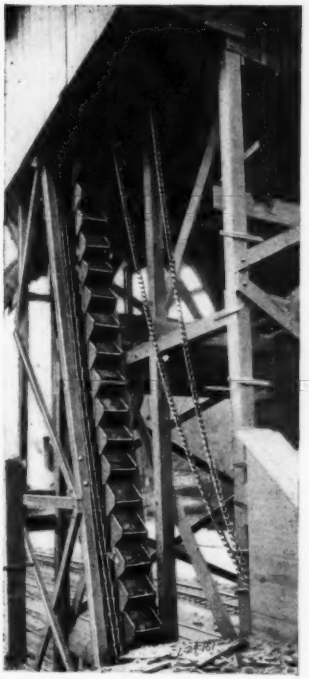

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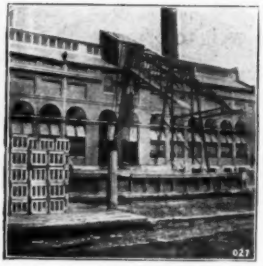

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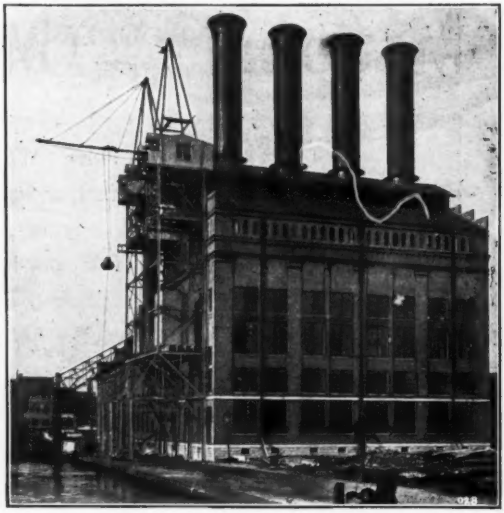

This is an addition to the plant shown on the left. It has just been erected by the United Railways and Electric Company of Baltimore, on Dugan's Wharf, adjoining the old station. These two views illustrate the remarkable development of the Electrical industry, and the progress made in power-house engineering during recent years.

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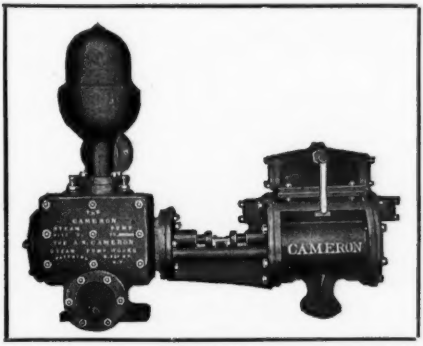


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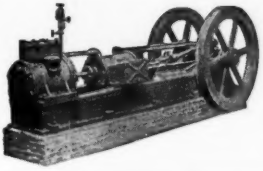

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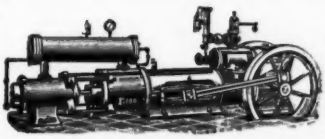

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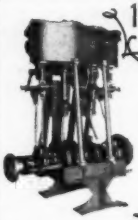

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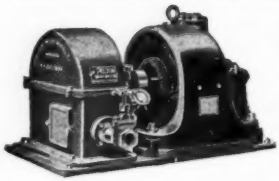

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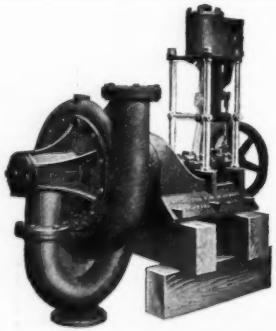

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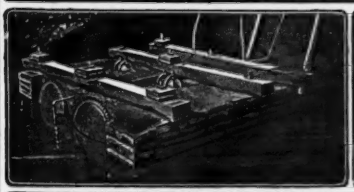

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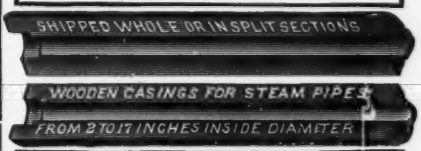


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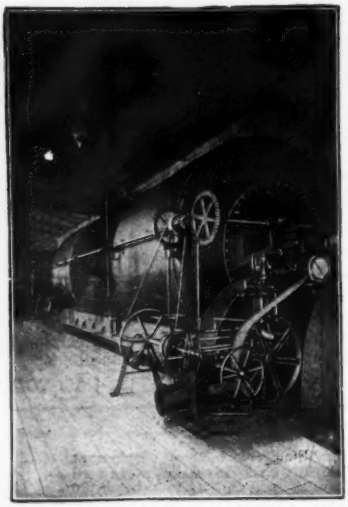

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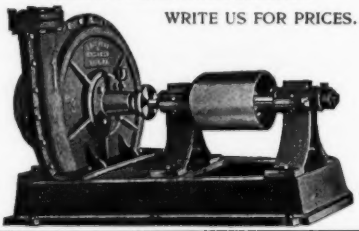

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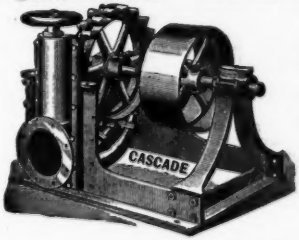


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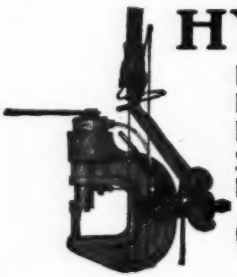

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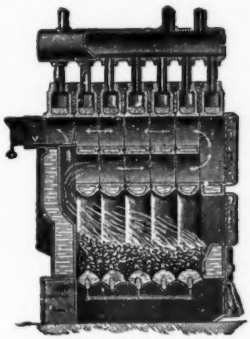

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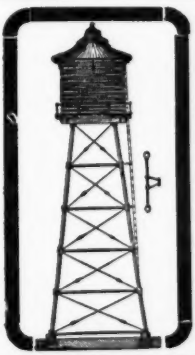

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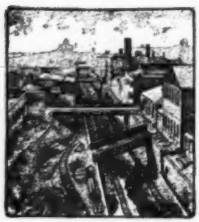

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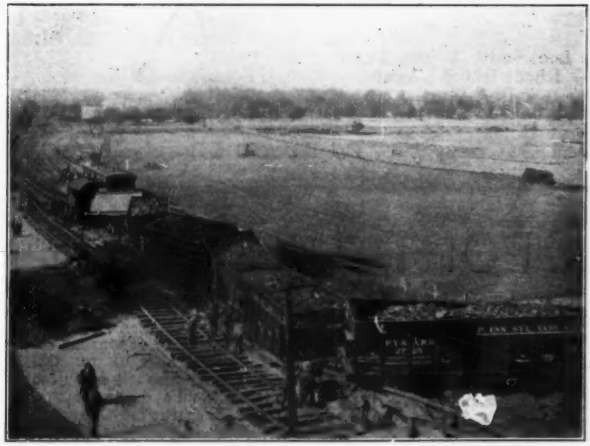

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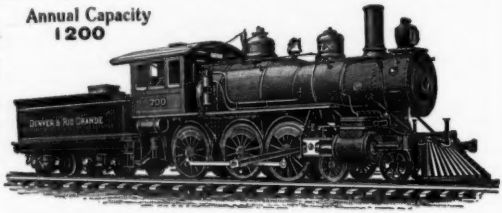

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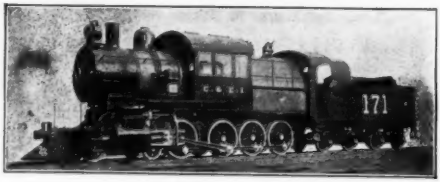

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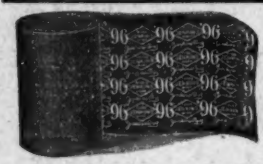

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